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NOTES AND COMMENTS.

Scientific Dinners.

NOW that the festive season is upon us, a few remarks on Scientific Dinners may not be out of place.

Most of the learned Societies meet once a year to celebrate their "anniversary," in a more or less convivial fashion. This they do, not in the style of the "good old days" of the "three-bottle" men—the process is in a measure reversed. Instead of a plain dinner and a large amount of wine, the custom is to have a very elaborate dinner and a moderate amount of wine. The cost may be much about the same.

In the meanwhile the composition of the societies has undergone considerable alteration. In old days, Science was the pursuit, or the pastime, for the most part of those well-to-do—of leading professional men, of clergy, and men of independent means. Nowadays Science owes its progress as much, perhaps more, to poor men than to the comparatively rich. Yet the annual dinners are practically restricted to the latter, on account of the guinea (or more) that is charged. This is not as it should be. To the younger workers, as a rule, the cost is prohibitory. These social gatherings should be representative: whereas, under present circumstances, it seems as if we had a Christmas dinner, and denied a place to the children and to our poor but hard-working relations. A change is needed, so that rich and poor, old and young, may meet, and equally find a welcome.

We read in the *Life of Edward Forbes* that during the meeting of the British Association held in Birmingham in 1839, "He and other young naturalists, disliking the irksomeness and expense of the ordinary, adjourned to a small tavern, adorned with the sign of the Red Lion. There they dined daily at small expense, on beef cooked

in various fashions, moistened with sundry potations of beer, and enlivened by joke and song—in contradistinction to the endless dishes and wines and formality of the 'big wigs.'"

"And in after years, when he had arrived at the zenith of his reputation, and British geology had conferred upon him the highest honours it had to bestow, his antipathy to men of buckram remained as strong as ever. He could see no reason why a President of the Geological Society should cease to be a 'Red Lion,' and so he chanted his songs and cracked his jokes as merrily as he had done in the little Birmingham tavern when he was only beginning to be known."

The Red Lion dinner, alas! is not what it used to be—with the formalities and expenses that seem to attend the introduction of "war-paint."

In making these remarks we have no desire to advocate a return to the customs of the past, nor to impair in any degree the true dignity of Science; but we fully believe that if the festive gatherings of our learned Societies were arranged on more economical lines, they would much more adequately fulfil the purpose for which they are instituted. In reference to the customs of the past, it will be of interest to append the following account of a Royal Society Club Dinner a century ago, taken from a translation of Faujas St. Fond's *Travels in England, Scotland, and the Hebrides*, 1799 (vol. i., pp. 48–51):—

"About forty members of the Royal Society have been, for more than twenty-five years, in the habit of dining annually in one of the taverns of London. Each member has the right of bringing to this club two visitors, whom he chooses, among foreigners or the friends of the Royal Society of his own acquaintance. The president may bring a greater number, and can select whoever he pleases for guests.

"We sat down to table about five o'clock. Sir Joseph Banks presided, and filled the place of honour. No napkins were laid before us; indeed there were none used; the dinner was quite in the English style.

"A member of the club, who is a clergyman (I believe it was the astronomer Maskelyne), made a short prayer, and blessed the company and the food. The dishes were of the solid kind, such as roast beef, boiled beef and mutton prepared in various manners, with abundance of potatoes and other vegetables, which each person seasoned as he pleased with the different sauces which were placed on the table.

"The beef-steaks and the roast beef were at first sufficiently drenched by large quantities of strong beer, called porter; it was drank out of cylindrical pewter pots, which are, by some, thought preferable to glasses, perhaps because they enable one to swallow a whole pint at a draught.

"This prelude being finished, the cloth was removed, and a handsome and well-polished table was covered, as if it were by magic, with a number of fine crystal decanters, filled with the best port, madeira and claret; this last is the wine of Bordeaux. Several glasses were distributed to each person, and the libations commenced on a grand scale, in the midst of different kinds of cheeses, which,

rolling in mahogany cases from one end of the table to the other, provoked the thirst of the drinkers.

"To give more liveliness to the scene, the president announced the health of the prince of Wales; this was his birth-day. We then drank to the elector palatine, who was that day to be admitted a member of the Royal Society. The same compliment was next paid to us foreigners, of whom there were five present.

"The members of the club afterwards saluted each other, one by one, with a glass of wine. According to this custom, one must drink as many times as there are guests, for it would be thought a want of politeness in England to drink to the health of more persons than one at a time.

"A few bottles of champaign soon put all the company in good humour. The tea came next, with butter, marmalade, and all its usual accompaniments; coffee followed, humbly yielding precedence to the tea, though it be the better of the two. In France, we commonly drink only one cup of good coffee after dinner; in England they drink five or six times that quantity of the most detestable kind.

"Brandy, rum, and some other strong liquors closed this philosophic banquet, which terminated at half-past seven, as there was to be a meeting of the Royal Society at eight o'clock. Before we left the club-room, the names of all the guests were written on a large sheet of paper, and each of us paid seven livres four sols French money: this was not dear.

"I repaired to the Society along with Sir Joseph Banks,—Cavendish, Dr. Maskelyne,—Aubert, and Sir [Henry] Englefield; we were all pretty much enlivened, but our gaiety was decorous.

"Doubtless, I should not wish to partake of similar dinners if they were to be followed by settling the interests of a great nation, or discussing the best form of government; such a conduct would neither be wise nor prudent; but to meet, to celebrate the admission of an elector palatine, who has, besides, much merit, to a learned Society, is not a circumstance from which any inconvenience can result."

Circumstances, as we have said, have changed much since the time of St. Fond's travels, and we can only hope that the conservatism of the older learned Societies will ere long be compelled to yield to the spirit of the age.

National Museums.

An article of some importance "On our National Art Museums and Galleries" is contributed by Sir Charles Robinson to the *Nineteenth Century* for December, 1892 (p. 1025), and many of his remarks will apply equally well to the National Scientific Collections. While fully appreciating the zeal with which the officers in charge of the various museums perform their duties, and while duly acknowledging the gratifying progress that is being made, Sir Charles laments the want of a central controlling organisation to direct the whole and prevent unnecessary duplication of specimens:—"It is little to say that in our museum system everything is in a chaotic state, everything drifts fortuitously; there is no central overruling and directive power, no bond of union, and scarcely any intercommunion between one

establishment and another—briefly, no definitely established system for the general governance of these institutions; hence tacit rivalries, which sometimes develop into flagrant antagonisms. The bounds of jurisdiction or the several provinces of these institutions overlap in all directions, and their respective interests clash."

Everyone acquainted with the Natural History Departments of the British Museum and the allied public institutions of more recent foundation, will recognise how appropriately these remarks apply to them. The originally economic aims of Kew Gardens, for example, have expanded to such an extent that the Herbarium is in constant rivalry with that of the British Museum, separating collections which ought to be united, and duplicating collections in other instances. The Museum of Practical Geology, also, continually acquires fossils which are of little or no value for stratigraphical or economic purposes, and which, from their unique interest in an anatomical sense, ought to be placed with the purely scientific collections in Cromwell Road. When the Art Museums are re-organised, by all means let the Science Museums be similarly controlled, and the reformation will be not merely economical, but conducive to efficiency.

The Botanist in Winter.

Though so many of our native plants lie dormant in the winter, the time is not lost even for them. We perhaps go into the lanes or fields and see only withered stalks, or ripe fruit waiting to be picked or shaken off. We say to ourselves that the year is finished, and nothing more is to be done till life revives with the first warm days of spring. This idea, however, is quite mistaken, for the botanist who has the good fortune to be in the field in winter sees things that are quite unknown to the summer rambler. He soon learns that though life may be dormant, or even extinct, in the dead stalks, yet they are not therefore merely cumbering the ground and waiting for decay. In many of our native plants the adaptation of the means to the end does not cease with life, and the dying or dead stem is often modified to help to protect or disperse the seeds.

Winter botany has been little studied, but there is much to be learnt. For instance, the dead, unsightly umbellifers, so common in every hedge, are still playing their part. Instead of the green, flexible stem found in the summer, we see a stiff, elastic stalk, with thin whip-like tips, from which the fruit, separating from the axis, dangle by one corner. Anyone who has seen boys throw pellets of clay by means of a switch, and has afterwards forced his way through dead umbelliferous stems, like those of the Wild Chervil, will at once realise the great use of the elastic stalk, the whip-like tip, and the divided carpophore with its dangling fruit. Each passing animal and every breeze bends the stalk, which, springing back, tends to fling the fruit well beyond the limit of the ground exhausted by the

parent plant. Thus the elasticity of the dead stem may be as important to the species as any character in the living plant.

Many annual plants, however, have burrs, and in these species the dead stem is more flexible and tougher, so that it bends and rubs the fruit against the fur of an animal, or against our clothing. The different character of the dead stem will at once be recognised in the Wild Carrot, the ripe burr-like fruit of which curl inward, so that they cannot be shaken off, but come away a few at a time when the plant is stroked by anything rough.

This is merely one example of what can be observed in late autumn and winter; but anyone who has visited a beech or oak wood during a gale in the fruiting season, will understand why such fruit grow on the tips of long flexible branches, instead of on thick stems. The stinging blow that can be given by an acorn under these circumstances will soon convince the naturalist of the important part played by the flexible branch. Even the gale that tears off large arms may be of great use to the species, though ruinous to the individual tree.

A Naturalist in the West Indies.

Mr. W. R. Elliott, who has been collecting Cellular Cryptogams during the last year in St. Vincent, Anguilla, and Dominica for the West India (Natural History) Exploration Committee, has met with considerable success. In his last expedition, he has made a prolonged examination of the highest peaks of Dominica, the most densely wooded and primitive of all the Antilles, except, perhaps, Hayti, "the black republic," of which very little is known. He has obtained a very large series of Hepaticæ which Mr. Spruce has undertaken to work out, while he has added to the large number of Fungi already collected and partly described by Mr. George Massee in the *Journal of Botany*.

Among other things of which Mr. Elliott has been in quest is the petrel, the Diablotin, supposed to occur only in Trinidad. He has found the holes frequented by the birds, and at the time of his last letter was awaiting the possible re-appearance of a stray specimen or two, since the season (November) had arrived at which this might be expected. He visited the Carib reservation of Salybia on the windward coast of the island, but his account adds little of note to that given of the expiring remnant of this people by Mr. Ober in his interesting *Camps in the Caribbees*, except that the race of true Caribs is now in much the same case as the Diablotin. It would be of interest, and even a negative result would be of some value, if a local naturalist of St. Vincent or Grenada were to examine, at the proper season, some of the higher, less accessible, and seldom visited island peaks among the Grenadines whence reports have come at different times of the appearance of a bird resembling the Diablotin.

THE SQUARE-MOUTHED RHINOCEROS.

IT has been considered that the square-mouthed, or so-called White Rhinoceros (*R. simus*) is already extinct. Recently, however, Mr. F. C. Selous has written to our contemporary, the *Field*, to say that a few of these magnificent animals still survive in a remote corner of Mashonaland. One of these last survivors has already been killed, with the view that its remains should find their way to the British Museum. We trust, however, that the authorities in Mashonaland will take care that the others are not molested, and may be allowed a chance of propagating their species.

We may take this opportunity of mentioning that although most zoologists have recognised the extreme specialisation of the molar teeth of this species, as exemplified by their very tall crowns, and the flat plane of wear of their grinding-surfaces, yet it does not appear to have been noticed that they differ from those of all other living Rhinoceroses by the presence of a thick investing coat of cement. Not only does this cover the outer surface of the tooth, but it likewise fills up both the main and the posterior valleys. Indeed, the molars of this species bear almost the same relationship to those of the Sumatran Rhinoceros as is presented by the molars of the Horse to those of the Anchithere.

In the extinct Woolly Rhinoceros (*R. antiquitatis*) the cement is present to a less degree in the molar teeth, which are of the same general structure; while in the allied *R. platyrhinus*, of the Siwalik Hills of India, there was, probably, also a certain amount of this constituent. In both these extinct species the teeth do not, however, appear to attain the extreme specialisation of the square-mouthed Rhinoceros, and it is accordingly difficult to regard the latter as representing a genus apart from the one including all the other existing species, which we should otherwise have been disposed to do.

THE SCIENCE OF GROWTH.

READERS of a recent article in NATURAL SCIENCE on the Anatomy and Development of the Brachiopoda, who were appalled by certain strange and fearful words, such as "nepionic," "ephebolic," and "nostologic," will be interested to learn that those terms have just been elucidated and improved by S. S. Buckman and F. A. Bather in a paper entitled "The Terms of Auxology" (*Zoologischer Anzeiger*, November 14 and 28, 1892, pp. 420 and 429). Growth and change, as the authors observe, do not stop in an animal when the embryonic stage has been passed; nor is the study of later stages of less importance than that of the earlier. Thus has arisen a new science, of which embryology is only a part; and, as was inevitable, definite names have been given to the various post-embryonic stages. Unfortunately, the names used were not only open to serious objection

on etymological grounds, but were used with too great laxity. As now revised, the technical terms are as follows:—*embryonic*, *brephic* (= infantine or larval), *neanic* (= adolescent), *ephebic* (= adult), and *gerontic* (= senile), the last being subdivided into *catabatic* (= declining) and *hypostrophic* (= atavic). These terms are restricted to stages in the growth of an individual. By prefixing the syllable *phyl-* they may be made to express stages in the history of a race; while the successive stages in the evolution of a character may be designated by the same terms with the addition of the prefix *morpho-*. Confusion of terms leads most surely to confusion of thought, and if the latter be in any way dispelled by the labours of Messrs. Buckman and Bather, we are bound to be grateful.

The Growth of Shells.

A most peculiar, and, as far as is at present known, unique mode of increase in a Gastropod shell, is described by Mr. B. B. Woodward in the last number of the *Proc. Zool. Soc. London* (1892, pp. 528—540, pls. 31, 32). Broadly speaking, the Gastropod shell may be looked upon as a more or less elongate conical tube, at the apex of which is the young shell, while increase takes place by the addition of fresh material at the other, open, extremity—the mouth. This tube is usually spirally coiled in the direction of a screw, the successive whorls touching one another. In those forms where the spire is low and the whorls are close together, the portion of the tube next the previously-formed whorl is sometimes largely, sometimes completely, dispensed with, and what was in the first instance the outermost wall of the tube becomes in the course of growth the dividing partition between the last whorl and its predecessor. When the shell is a very thick one, the presence of an equally stout internal partition (*paries*) between the whorls becomes unnecessary, and even inconvenient; hence it is very frequently to a great extent re-absorbed and reduced in thickness by the animal, as, for example, in *Conus*.

The Neritidæ advance a step further, and usually remove the greater part of the paries altogether, converting the shell into a single chamber, the only remnant of the dividing wall left being a portion near the mouth, to which one of the retractor muscles is attached. On the other hand, this remaining fragment of paries is usually strengthened, sometimes considerably, by an extra layer of shelly material. In extreme cases this deposit forms an independent projecting shelf (*septum*), standing out from the paries into the general cavity, between the former and the mouth of the shell. In these instances the septum forms the point of attachment for the retractor muscle, and the remnant of the paries is reduced to insignificant proportions or disappears entirely. The different species of *Neritina* and *Nerita* exhibit the various stages in the process.

Another feature of the Neritidæ is the presence of a thick shelly deposit (the *callus*) just without the mouth, on the surface of the last whorl. This deposit is thickest at the margin next the mouth, and generally at this point forms a ridge or even a thin shelf, or septum, which stretches partly across the mouth, reducing it in size. The full edge of this shelf is often serrate, sometimes coarsely so. As the animal grows and adds to its shell, still winding round in a spiral direction, these various deposits advance with it by the simple process of the addition of fresh material on their outer sides (using the word "outer" in its relation to the mouth and the direction of growth), and the removal of a corresponding amount on their inner sides.

Having prefaced so much, it is easy to understand the interest of what took place in the most eccentric Eocene member of the family, *Velates conoideus*, Lamk., as described by Mr. Woodward. In this species the growth of the young shell was perfectly normal, but when it had completed about $4\frac{1}{2}$ whorls a remarkable change ensued; it ceased to grow spirally, and increased by the addition of fresh layers of shell over the whole surface of the callus as well as round the margins of its mouth, and gained the additional internal space the animal required by the removal of a corresponding amount of shell on the inner side of the callus. It thus changed both its direction and axis of growth—and like the Irishman, it raised its roof by digging out the floor of its tenement. In a full-grown specimen, therefore, nearly half the shell and the internal septum were carved out of former callus, the layers of which can be seen in sections cutting across the walls and running round on the inner surface. A still more remarkable feature is presented in the disposition of the component plates which, in the callus, are so arranged as to provide, in anticipation, the strongest possible structure for the muscle-carrying septum, ultimately to be sculptured out from it. The presence of silica in the outer layer of the shell is also noteworthy, and it is interesting in this connection to remark that one of the earliest describers of this fossil gastropod, and the author after whom it is sometimes called—C. C. Schmidel—observed, in 1780, that this outer layer did not appear to consist entirely of lime.

The Classification of Bivalved Shells.

After the embryologist has made a certain advance in the study of development, and the comparative anatomist has progressed in the determination of homologous parts, the services of the systematic zoologist are required to express the results in orderly sequence. Classifications are thus merely temporary expedients—generalised retrospects, so to speak—and every advance demands some reconsideration. At the present time Professor Carl Grobben (of Vienna) is of opinion that some reform is necessary in the classification of the

bivalved mollusca; and he publishes the following scheme in the *Zoologischer Anzeiger* for October 24 (vol xv., pp. 373—375) as most in accordance with the existing state of knowledge:—

Class: LAMELLIBRANCHIATA (PELECYPODA).

Sub-Class I.: PROTOBRANCHIATA.—With double comb-shaped gills; hinge toothless or with interlocking denticulations of the hinge-border or taxodont. Families: Vlastidæ, Cardiolidæ, Antipleuridæ, Lunulicardiidæ, Præcardiidæ, Silurinidæ, Protomyidæ [*Solenomya*], Solenopsidæ, Grammysiidæ, Posidonomyidæ, Daonellidæ, Nuculidæ.

Sub-Class II.: DESMODONTA.—With double lamellar gills; hinge-teeth wanting or irregular, arising in intimate connection with the ligament supports. Families: Pholadomyidæ, Myidæ, Anatinidæ, Panopæidæ, Septibranchia, Mactridæ, Pholadidæ, Gastrochænidæ.

Sub-Class III.—AMBONODONTA. With double lamellar gills; hinge-teeth inclined backwards on the hinge-plate of the shell, variable in position, may be wanting.

Order 1. *Eutaxodonta*. With taxodont hinge. Family: Arcidæ.

Order 2. *Heterodonta*. With heterodont hinge. Families: Astartidæ, Crassatellidæ, Chamidæ, Lucinidæ, Cardiidæ, Tridacnidæ, Cyrenidæ, Cyprinidæ, Veneridæ, Solenidæ, Tellinidæ, Donacidæ.

Order 3. *Schizodonta*. With schizodont hinge. Families: Trigoniidæ, Najadæ.

Order 4. *Anisomyaria*. Hinge-teeth wanting, or if present, isodont or irregular; with two very dissimilar hinge-muscles or merely a single hinge-muscle. Families: Aviculidæ, Mytilidæ, Pinnidæ, Pectinidæ, Spondylidæ, Ostreidæ, Anomiidæ.

THE CURVATURE OF PLANTS.

MR. FRANCIS DARWIN and Miss D. Pertz have lately been studying the artificial production of rhythm in plants, and the results appear in the last number of the *Annals of Botany*. The observations were made with the help of a new machine devised by the authors, which they call an intermittent klinostat. It differs from the ordinary klinostat in that movement is allowed only at regular intervals. The spindle is connected with a clock in such a way that a half rotation, *i.e.*, of 180 degrees, occurs at the end of every half-hour. Experiments were made with relation both to geotropic and heliotropic curvatures. In the former series, shoots of valerian and stalks of dandelion were used; these were fixed through a bored cork in test-tubes of water, which were attached horizontally to the spindle. The machine was placed opposite a window to cancel the effect of light in causing curvatures. When the clock was working, the influence of gravity on the growing shoot or stalk was, of course, reversed every half-hour, and it therefore received a stimulus of equal duration to curve towards opposite sides.

After the first few half-hourly intervals, the curvatures in either direction continued regularly for about thirty minutes. If the clock

were stopped, the rhythm was found to persist for a short time, the shoot or stalk actually curving in opposition to gravity for the half-hourly interval before finally obeying the impulse to grow downwards.

A similar effect was observed with heliotropic curvatures, for which seedlings of canary grass were used, the rotation being, of course, in a horizontal plane.

In one case, after the clock was stopped, the seedlings curved away from the light, for *two* half-hourly intervals, separated by one of curvature towards the light, so strongly were they imbued with the artificially-induced rhythm. The authors were evidently much struck with the result of their experiment; "to watch the movement of the free end of the shoot," they say, "and to see it reversed exactly at the expiration of half an hour is an experience so impressive as to compel belief. When a shoot is in a thoroughly rhythmic state, it is possible to prophesy to a minute at what time the reversal will take place." They compare the persistence of the rhythm after cessation of the stimulus to habit, like that acquired by a man who, after being regularly called for a time at 6 a.m. will awaken of his own accord at that hour. In the case, however, of the man, something in his surroundings, such as duration of light, may unconsciously affect him, but in the above experiments with plants, no such factor can have intervened, and the rhythm must be the result of an "internal chronometry," associated probably with the course of nutrition.

Recent Progress in the Study of Algæ.

The subject of the diseases of seaweeds is beginning to attract attention. So far, all that is known relates to the familiar *Vaucheria* galls and to the occurrence of Chytridieæ in *Sphacelaria*, *Cladostephus*, *Ceramium*, &c., as recorded by Magnus in the German North Sea Commission's Reports; while there are two papers by Miss Barton, one on galls in *Rhodymenia* caused by a copepod (*Journ. Botany*), and another on the malformations of *Ascophyllum* and *Desmarestia* (*Phycological Memoirs*). The thread-worm (*Tylenchus fucicola*), which causes the malformation of *Ascophyllum*, has been minutely described and beautifully figured by Dr. de Man in the recently issued *Festschrift* in honour of Professor Leuckart. Dr. Schmitz has described, at the British Association, Edinburgh, and in the *Botanische Zeitung*, certain tubercles of Florideæ, caused by the inevitable Bacteria; and a further contribution of great interest will shortly be made to the subject by Miss Frances Whitting, who is studying remarkable malformations of *Sarcophycus*, a Fucaceous Alga of the southern seas. This note of the literature of the subject may serve to call further attention to a very promising field of study.

A very admirable example of true methods in the study of Cryptogamic Botany is to be found in a memoir on the Algæ of P. K. A. Schousboe, contributed by M. Ed. Bornet to the *Société*

nationale des Sciences naturelles et mathématiques de Cherbourg (vol. xxviii., 1892). These Algæ were collected so long ago as 1815–29 by Peter Schousboe, Danish Consul at Morocco, and a part of them were bought by the King of Denmark, who placed them in the Botanic Garden of Copenhagen. The rest, together with a herbarium of Phanerogams, came into the hands of M. E. Cosson, and the late M. Thuret undertook and began the working out of the Algæ. He did not live to complete his labour, but sets were distributed by M. Kralik, under the name of *Algæ Schousbœanae*, and the British Museum possesses a very excellent one. M. Bornet has set to work on the complete series in Herb. Thuret, and the result is the admirable treatise just issued. The numerous phycologists who have found trouble in dealing with the *Algæ Schousbœanae* will be able to appreciate this authoritative publication, and especially the valuable critical notes on the species, as excellent and useful as any systematic work yet done by the great French botanist. A good deal of it will have particular interest to those who study seriously the distribution of our Channel Algæ.

Mr. James Ellis Humphrey, at present attached to the Agricultural Station at Amherst, Mass., is about to visit Jamaica for the purpose of working specially at the Algæ of that island. He intends to pay attention to the development of the multinucleate forms and in so rich a field is sure to meet with rewards.

Recent Progress in the Study of Fungi.

Among new mycological literature, the *Vegetable Wasps and Plant Worms*, by M. C. Cooke, furnishes an account of the Fungi that prey upon insects. His book is based on the privately-printed *Insect Bases of Fungoid Parasites*, by G. R. Gray (1858). Dr. Cooke brings it up to date in his own way, which is not remarkable for severe accuracy, but the result is a guide, at all events, to the literature of the subject.

Messrs. Ellis & Everhart's *North American Pyrenomycetes* has at last appeared and in a ponderous form. It is an excellent piece of work, and, so far as we have tested it, errs only in the references not being sufficiently exhaustive—especially the earlier historical references, if these may be so distinguished from the more modern.

Mr. Massee, whose activity in book production threatens Dr. Cooke's supremacy in this respect, has produced the first volume of his *British Fungus Flora* (Bell & Sons). Mixed with much that is both acutely and shrewdly critical, there is considerable credulity in the matter of taking references and statements for granted as correct. This kind of credulity may be beautiful as a matter of sentiment, and convenient in cases of haste, but it makes a vast difference to the value of a book.

An interesting and very comprehensive book on the truffle, by M. A. Chatin ("La Truffe," Baillière et Fils, Paris), has just been

published. It is a good example of the varying "form" displayed by a scientific author, his present effort being as successful as his *Anatomie Comparée* was the reverse.

IT is interesting to remark how the skeletons of animals that we have always hitherto regarded as typically Old World forms of life are still being discovered in the Tertiary formations of North America. The latest announcement is that of the discovery of a hyæna by Professor Cope in the Pliocene formation of Texas. It is an animal about as large as the common spotted hyæna, and is only known to differ from *Hyæna*-proper in the possession of a fourth premolar in the lower jaw. It is named *Borophagus diversidens* (*American Naturalist*, 1892, p. 1028). With the hyæna were also found two tortoises, one bird, one sloth, three mastodons, one peccary, three horses, one camel, a weasel, and a large cat. One of the horses—a true *Equus*—is remarkable for its small size, the teeth being no larger than those of a sheep.

SIR HERBERT MAXWELL and Mr. J. E. Harting, the Chairman and Secretary respectively of the Committee appointed by the Board of Agriculture to investigate the plague of field voles in Scotland, will shortly proceed to Thessaly to examine the results of Professor Loeffler's work in that region. As is well-known, the Professor has attempted to exterminate the Thessalian voles by placing in their food the germs of mouse typhus, and he claims to have been successful.

THE important monograph on the development of the macrurous Crustacea, by Professor W. K. Brooks and Mr. F. H. Herrick, to which we referred some time ago (vol. i., p. 243), has lately been issued in vol. v. of the *Memoirs of the National Academy of Sciences*. The other memoirs in the same volume relate to physical subjects.

WE have received from Mr. Hugh Fulton a photograph of the beautiful little land-shell, *Opisthostoma mirabile*, discovered a short time ago by Mr. A. H. Everett in North Borneo. In ornamentation this minute species rivals the *O. grandispinosa*, and several specimens have lately been obtained by Mr. Fulton.

IN the recently-issued number of the *Annals of Botany*, Dr. Schunck gives a short account of the work done on the chemistry of the green colouring matter of plants (chlorophyll) since the publication of his former paper on the subject in the volume for 1889.—In the same journal Mr. R. A. Rolfe describes a natural hybrid

between the frog orchis (*Habenaria viridis*) and the spotted orchis (*Orchis maculata*). It was found at Longwitton, in Northumberland, and shows, in a marked manner, a blending of characters derived from its two very distinct parents. The spur, for instance, is neither long nor short, but intermediate between the forms characterising the *Habenaria* and *Orchis* respectively. The hybrid receives the somewhat formidable name of *Habenari-orchis viridi-maculata*.

ATTENTION has been directed to the subject of Lunar Volcanoes by Mr. J. B. Hannay (*Nature*, vol. xlvii., p. 7). He thinks that many of the craters look more like some disturbance in a semi-liquid surface than an accumulation of volcanic *débris;* and remarks that the rise and fall of a fused slag through holes in its solidifying crust, form features exactly like the craters in the moon. He suggests that, in the case of the moon, the rise and fall would be caused by the tidal motion of its still liquid interior. Mr. S. E. Peal also enquires (*Geological Magazine*, Nov., 1892, p. 501) whether the moon "could retain from the igneous-molten era, to its present *intensely* cold, airless and waterless condition its pristine surfacing, the very poles themselves being covered (it is urged) with large and small volcanoes, untouched by the hand of time." He has, however, written a book, which he speaks of as "my Theory of Lunar Surfacing by Glaciation."

THE supply of natural gas and petroleum in Canada does not yet approach in importance that of the United States; we are glad to see, however, by the recently-issued First Report of the Bureau of Mines, 1891 [Ontario], that the industry is making steady progress. An Act has wisely been passed to prohibit the wanton waste of the by no means inexhaustible supply, and to provide for the compulsory plugging of unused bore-holes. The same report shows that nickel mining, of which so much was expected, progresses but slowly, the new alloys of nickel-steel not having yet come into use to any great extent. The ore is a mixture of copper-pyrites and nickeliferous pyrrhotite, usually associated with greenstone.

AN interesting discovery of Lithographic Stone is recorded in the seventh volume of the *Mineral Resources of the United States*, lately issued by the U.S. Geological Survey. Material of excellent quality, comparing very favourably with Bavarian stone, has been found near Little Rock, Arkansas; and stone that has been tested and found serviceable, occurs at Fincastle, Virginia, and also in Blanco County, Texas. Preparations have been made for working the stone at the three localities. In England, trials for Lithographic

Stone have been made of slabs from the Lower Lias and White Lias (Rhætic) Beds, but not, so far as we know, with satisfactory results.

THE new part of the *Proceedings of the Geologists' Association* contains an interesting account, by Mr. W. J. L. Abbott, of the deposits and fossils found in excavations made for the foundation of the new Admiralty buildings at Whitehall. Full lists of the fossils are given, the most interesting finds being an undetermined species of water-tortoise (*Emys*), and leaves of the Arctic birch (*Betula nana*). This is the first time any Arctic plant has been found fossil in the Thames valley, and the water-tortoise in Britain was known only from Norfolk.

GEOLOGISTS will be glad to learn that a series of unpublished papers and notes by the late Professor Carvill Lewis, on the Glacial Geology of Great Britain and Ireland, will shortly be published as a small volume by Messrs. Longmans & Co. Dr. H. W. Crosskey is preparing an introduction.

A BIOGRAPHY of the late Sir Andrew Ramsay, who was for nine years Director of the Geological Survey of Great Britain, is being prepared by his successor, Sir Archibald Geikie.

A NEW monthly journal of Ornithology, the *Ornithologischen Monatsberichte*, is announced by Messrs. Friedländer & Son, of Berlin. The first number is to appear this month, and the annual subscription is 6 marks. The editor is Dr. Ant. Reichenow, and the main object of the journal appears to be the publication of brief preliminary notes on new researches, with a detailed index to current ornithological literature.

THE World's Fair at Chicago possesses an unusual interest from a Hygienic point of view. The probability is that cholera will break out again in Europe next spring. Whatever may be the vehicle of the cholera germs, it certainly tends to spread along the route where those who are affected have passed. It would certainly more or less affect the success of the Fair if intending visitors had any suspicion that dangers arising from this source were not entirely under control. There is also some reason to suppose that Chicago is well suited to become a sort of headquarter for this disease. In 1891 the typhoid fever death-rate of Chicago was twelve times as great as that of London. This state of the public health points to a water supply contaminated by germs, and it is natural to expect that, if the cholera germ by any means reaches Chicago, the water supply would be one of the most efficient means of spreading it.

One Jacob Horner has written a book called "Did a Hen or an Egg exist first? or My Talks with a Sceptic." One Mr. James Crompton has edited it, and the Religious Tract Society have published it in London in 1892. Mr. Jacob Horner says in the preface that he has found many of the artisans intelligent, that they are fond of an argument, that they want to understand the grounds of religion. "They like to get hold of a smart book with some dash and 'go' in it." Therefore has this book been written. It is a series of dialogues between an uncle and his nephew Tom Rod, "who has taken it into his head to be a Freethinker." In each round the stuffing is very agreeably knocked out of Tom till, at the end of the book, he writes a letter, the purport of which is that he can't come up to time again until he has been refilled. The stuffing is the very worst and oldest we have ever seen. It is, in fact, so bad, that it is hardly worth while pointing out that the nimble Uncle's blows are nearly all fouls. Take the first round as a sample. For brevity, we take the blows only and leave out the feints:—Uncle: Did a Hen or an Egg exist first? Tom objects to question. Uncle explains, and Tom admits that every egg comes from a hen, every hen comes from a chicken, and every chicken from an egg. Uncle puts in that Sir Charles Lyell says "You must explain the past by the present." Tom admits. Uncle: This must have held in the past. Tom admits. Therefore, first egg must have come from first hen, and so the first hen must have existed before the egg, and could not have come from an egg; and so Lyell's principle breaks down; you can't explain the past from the present. Stuffing badly out. There are 96 pages of this sort of thing. The last chapter is very appropriately entitled "Where are you going?"

Our first article this month relates to the life and works of Sir Richard Owen, who died on December 18. At the moment of going to press we regret to learn that the conspiracy of silence so long prevailing in certain quarters as to the great anatomist's writings, extended even to the arrangements for his burial. We have to record that a public funeral was not even offered, and Sir Richard Owen's remains were interred in Ham Churchyard in the presence of a small gathering of personal friends and official representatives of the scientific institutions of London.

I.

Owen.

I.—BIOGRAPHICAL NOTICE.

IT is with deep regret that we record this month the death of Sir Richard Owen. The ablest comparative anatomist of his time, Owen ranks with Darwin and Lyell as one of the greatest naturalists that England has yet produced.

Born at Lancaster eighty-eight years ago, Richard Owen received his early education at the local grammar school, and became, at the age of twenty, a student at Edinburgh University. His activity and talents enabled him to reap the fullest advantages offered by his teachers, among whom were Wm. Pulteney Alison, T. C. Hope, Robert Jameson, Alexander Monro (the third), and Alexander Barclay; and in 1825 he had already been elected President of the Hunterian Society, which he and others had formed a short time before. Leaving Edinburgh in 1826, Owen joined the medical school of St. Bartholomew's Hospital, where he came into contact with the celebrated John Abernethy. It was, it is interesting to note, to the Medical Society of this hospital that he presented his first published paper, "An Account of the Dissection of the parts concerned in the Aneurism, for the cure of which Dr. Stevens tied the Internal Iliac Artery," which appeared in the *Medico-Chirurgical Transactions* for 1830.

In the year 1826, he became a member of the Royal College of Surgeons, and contemplated entering the Naval Service. Fortunately, however, for Science, Abernethy, recognising the material in the man, obtained for him a post at the College of Surgeons, as assistant to William Clift. From this moment, the brilliancy of Owen's genius commenced to shine, and for fifty years, until age overclouded it, remained undimmed. His first work at the College of Surgeons was to assist Clift in the preparation of Catalogues of the Museum, which had been mainly formed by the anatomist, John Hunter, a man Owen greatly revered, and whose works he later on edited from the manuscripts rescued by Clift from the vandalism of Everard Home.

The publication of a detailed and exhaustive paper on the pearly nautilus (*Nautilus pompilius*), in 1832, at once raised Owen to the foremost rank of working naturalists. Not only was this memoir

complete in a zoological sense, but the views on structure and affinities therein expressed were considerably in advance of his contemporaries.

Continuing the work on the Hunterian specimens after the death of Clift (1849), to whose position as curator he succeeded, Owen issued many special catalogues of the collections, completing the series in 1854. During his twenty years' curatorship of the College of Surgeons, he so rearranged and added to the Hunterian Collections that in 1856 they filled ten times the original space allotted to them, and were suitably housed and displayed in three large galleries specially erected for the purpose.

Owen became public lecturer in comparative anatomy at St. Bartholomew's Hospital in 1834, and in 1836 succeeded Sir Charles Bell as Professor of Anatomy and Physiology in the College of Surgeons. He was also appointed in the same year to be the first "Hunterian Professor" at that institution. He became a Fellow of the Royal Society in 1836, in 1839 was made LL.D. of Cambridge, and in 1843 was elected F.R.C.S. Three years previously he founded the Royal Microscopical Society, and became its first President. In 1844 he was appointed to the Commission of Enquiry on the Health of Towns, and reported on his birthplace, Lancaster. He served also on commissions on the Health of the Metropolis and on Smithfield Market, was president of one of the juries at the Great Exhibition in 1851, and in 1855 filled the same position at the Exposition Universelle, Paris. In 1852, Owen was made D.C.L. of Oxford, and received the same year "Le Prix Cuvier" from the Institute of France, an honour peculiarly acceptable to one who had so industriously and brilliantly followed in the footsteps of that master.

Owen's connection with the College of Surgeons ceased in 1856, when he accepted the Superintendentship of the Natural History Department of the British Museum. Once in this position, he ceaselessly urged the necessity of more space for the growing collections, and in 1859 his "Report, with plans, of a National Museum of Natural History" was ordered by the House of Commons to be printed. Building operations eventually commenced in 1873, and the Museum in Cromwell Road was finally completed in 1880. It is, however, only fair to state that the building as finished but little represents Owen's ideas; one has only to look at his report and plans to recognise his knowledge of what was required, and to see how much the arrangement of the building has been sacrificed to architectural peculiarities. In recognition of his great services to science, Owen received the honour of knighthood on his retirement from the Natural History Museum in 1884.

Richard Owen was a giant, both in stature and in intellect, and the best monument that can be raised to his memory already exists in the Palæontological Galleries of the British Museum. Label

after label calls to mind that Owen first studied and described the remains exhibited, and though he was not free from the errors of the early investigators, and was very jealous of his contemporaries, his triumphs will linger in our memories longer than his weaknesses or mistakes.

Few students realise the magnitude of Owen's work, and it is only those who search in many fields that can comprehend the genius of the man who has now passed to his rest.

C. DAVIES SHERBORN.

II.—SIR RICHARD OWEN'S HYPOTHESES.

IT is now more than sixty years since the Zoological Society published the earliest of those anatomical papers on the Anthropoid Apes, among the later of which was the first thorough and detailed description of the skulls of the Chimpanzee and Gorilla. These, together with skilful restorations of the extinct birds of New Zealand and many other anatomical papers well-known to zoologists, will cause the name of Owen long to live in the grateful memory of all men who have the cause of Natural Science at heart. It seems, indeed, that the fame of our veteran Comparative Anatomist is likely rather to augment than decline. As time goes on and the disputes which formerly arose about the precise definition of "corpus callosum," and the presence of the "hippocampus minor" fade from memory, the many merits of the greatest English Zoologist of the first half of the nineteenth century will, we think, be more and more generally recognised. The esteem in which he has continued to be held during recent years is clearly shown by the award to him by the Council of the Linnean Society of their first Zoological Medal.

However Sir Richard Owen may in some respects have laid himself open to criticism, he has certainly been the victim of some injustice. It may be that a sense of such unfairness had its influence in that award to him of the Linnean Medal to which we have just referred.

This injustice mainly concerns some of his fascinating hypotheses relating to the essential nature of the processes of generation and repair, and concerning certain archetypal principles of our own bodily structure which he first made familiar in England.

We well recollect a brilliant lecture given at the College of Surgeons concerning "virgin reproduction," to which process, so far as we are aware, Professor Owen first applied the term Parthenogenesis. This lecture, revised and enlarged, was subsequently published.[1] It is with respect to this that a great injustice has been committed. It has been, no doubt, unwittingly committed by men who, while lauding or criticising Professor Weismann for his more

[1] On Parthenogenesis. London: John Van Voorst, 1849.

recent contributions to science, have failed to refer to the work and the hypothesis of their aged and illustrious compatriot. Yet in many respects he most certainly anticipated the ideas of the Freiburg Professor,[2] as we have before been careful to point out. It is, however, not so much Owen's hypothesis with respect to virgin reproduction that we desire here to refer to, as to that concerning his ideal generalisations with respect to the structure of vertebrate animals.

At the British Association meeting of 1846, and in his work on the Anatomy of Fishes, published in the same year[3], he put forward views which were fully developed in his work entitled "On the Archetype and Homologies of the Vertebrate Skeleton," published[4] in 1848, and further illustrated in his book, "On the Nature of Limbs,"[4] on the frontispiece of which the human and bovine structures are represented in juxtaposition, much as the skeletons of man and horse have been recently placed in juxtaposition by Sir Richard Owen's most able and indefatigable successor in the directorship of the British Museum of Natural History.

Owen's views were essentially those of Oken, as he lets his readers very plainly know. At page 73 of his work on "The Archetype," speaking of the vertebrate theory of the skull, he says:—"The gifted and deep-thinking naturalist, OKEN, obtained the first clue to this discovery by the idea of the arrangement of the cranial bones of the skull into segments, like the vertebræ of the trunk. He informs us that walking one day in the Hartz forest, he stumbled upon the bleached skull of a deer, picked up the partially dislocated bones, and, contemplating them for a while, the truth flashed across his mind, and he exclaimed, 'It is a vertebral column!'"

Sir Richard Owen's notion was that the skull consists of four vertebræ, with sense organs at the anterior part of each of its four osseous rings. The ear-capsule, in front of the first of the four (the occipital vertebra); the nerve ministering to taste in front of the second, or hinder sphenoidal vertebra; the organ of sight at the front of the third cranial (anterior sphenoidal) vertebra; and that of smell at the anterior part of the fourth or ethmoidal vertebra. He clearly shows (p. 74) how in all this he had been anticipated by Oken, and, on the next page, adds: "This will serve as an example of the close observation of facts, the philosophical association of their relations and analogies, and, in a word, of the spirit in which Oken determines the vertebral relations of the cranial bones. . . . ." Reverting to the petrosal, Oken thus beautifully and clearly enunciates its essential nature and homology:—'You will say I have forgotten the part petrosa. No! it seems not to belong to a vertebra, as such; but to be a 'sense-organ,' in which

[2] In the number of *Nature* of November 14, 1889.

[3] By Longman, Brown, Green and Longman. [4] By John Van Voorst.

[5] Also published by John Van Voorst.

the ear-nerve loses itself; and therefore as distinct an organ from a vertebral element as is any other viscus, or as is the eye-hole itself.' Although Oken does not in this essay formally admit a fourth vertebra anterior to the eye vertebra, he recognises the vertebral structure as being carried out rudimentarily or evanescently by the vomer . . . or the nasal bones."

Now we need hardly say that we do not give this citation with any intention of implying that the views of either Oken or Owen are true; but merely to show that the English naturalist did justice to his German predecessor—even to his suggestions with respect to the vomer and nasals, which are just those which Sir Richard Owen advocated.

In the present day both Oken's and Owen's archetypes have become obsolete, and we suppose no one now maintains them. Nevertheless, when they were first promulgated here, they produced no slight effect, they drew many thoughtful minds towards questions of biology, and they roused an antagonism which has also led to much valuable work. We believe them to have been, in these different ways, very serviceable to science, but we also think that they embodied, or were the mistaken outcome of, some deep and very significant truths which are, in general, far too little appreciated, a wave of sentiment, and the influence of a party (which could do much to make or mar a young man's progress), having combined to indispose many minds towards a dispassionate appreciation of them.

Personally, well disposed as we have always been to Owen, the Hunterian Professor, on account of much courtesy and kindness shown to us by him, we never accepted his representations in any detail, and were quickly convinced that he was quite mistaken as to his "Petrosal" in the lower Vertebrates. Although adopted by not a few persons, some of his views invited hostile criticism, and were soon attacked as being inconsistent, as they obviously were, with the facts of development. It was urged that the skull was made up of modified vertebræ. Its vertebrate character should be plainest in its earliest and least modified stages, and yet such stages had no resemblance to vertebræ at all. It was also pointed out that basilar cartilage and trabeculæ cranii were unlike anything to be found in the incipient vertebral column, the segmentation of which was sufficiently accounted for by the necessary action of pressures and strains on any frequently flexed cylindrical body. A flood of ridicule and sarcasm was poured on Owen's hypothesis, and the doctrine of archetypal ideas was supposed to have received its *coup de grace* from the theory of "Evolution," and above all, from that of "Natural Selection."

But Sir Richard Owen did much more than propound a modified Okenian theory of the skeleton, and indeed it would be a great injustice (an injustice which, nevertheless, has been ruthlessly perpetrated) to represent his theory as *mere* Okenism; for Owen gives no

sign of ever having entertained the fanciful notion that the head was a repetition of the whole body. By the clear and emphatic distinction he made between *Analogy* and *Homology*, by his account of special and general homologues, and by his exposition of serial and lateral homologies, he spread abroad in England the perception that a deep significance underlies the structure of animals—a significance for which no stress and strain, and no influence of heredity, and certainly no mere practical utility, can account.

The temporary overclouding of this perception through the retrograde influence of Darwin's hypothesis of "Natural Selection" is now slowly, but surely, beginning to pass away; for which no small thanks are due to the efforts of his zealous disciples, Professors Weismann and Romanes. It would be out of place to trouble our readers with a restatement[6] of simple facts of lateral and serial homology; we will confine ourselves to once more repeating the assertion that homologies for which neither heredity nor utility will account, reveal themselves in the limbs of chelonians, birds, beasts, and most notably in those of man.

It was, in all probability, a clear perception of this fundamental fact of animal organisation which led Sir Richard Owen at once to reject with disdain the teaching inculcated in the Origin of Species, a teaching eagerly welcomed by that Teutonic "wearer of motley" by whom, as Professor Cunningham well says,[7] *Halophysema* and *Gastrophysema* were "specially created," by the creator of *Bathybius*, and by that prolific Professor at Freiburg whom the destruction by facts of some utterly gratuitous hypotheses, does not for a moment deter from troubling us with others no whit less gratuitous than were their predecessors.

But to return to archetypal ideas and theories as to the nature of the skull. In the first place exception must be taken to embryology as the test. For, if we carry back such researches to the incipient germ, we shall find no available characters for discrimination at all, while diversities of interpretation of nascent structures are almost always possible, and the meaning of initial changes must be elucidated by the study of subsequent changes.

Thus, Professor Huxley tells us,[8] as to *Menobranchus*, that "no definite answer can be given" to the question whether the trabeculæ "grow into adjacent tissues as a tree pushes its roots into the soil," or whether their apparent distinction does not "arise rather from a chondrification of the pre-existing tissue in the immediate neighbourhood of the trabecular cartilage?"

Then, when ossification sets in, the meaning of the several ossific centres, as they arise, must be interpreted by their later stages. How

[6] Readers interested in such questions may be referred to Proc. Zool. Soc., 1884, p. 462.

[7] NATURAL SCIENCE, September, 1892, p. 544.

[8] Proc. Zool. Soc., 1874, p. 199.

else could epiphyses ever be discriminated? Again, the circumstance of a bone or cartilage making its appearance as a single element may in any case be due to the junction of its incipiently distinct parts at a period anterior to possible observation; it may be *connate*, *i.e.*, never distinct to observation, though judged from analogy to be essentially multiple. Of such rationally-inferred but invisible distinctness, we have examples in botany. The *results* of development are surely as much to be considered as are its earlier stages.

As to the vertebral or non-vertebral nature of the skull, it seems to us that such vertebral nature may be affirmed in one sense and denied in another, according to the line of thought which is followed.

It is undeniable that it is within the *laminæ dorsales* of the embryo that the cartilages and bones of both the brain-case and of the dorsal portion of the spinal cord are alike formed. Certainly also the bones of the skull—especially in the higher animals—present a singular reminiscence of vertebræ in the three serially successive arches they form; and if the essence of vertebræ consists in their being a series of bony rings fitted together, and serially enclosing the nervous centres, then, in that sense, the skull is in part composed of three vertebræ. In some fishes (*e.g.*, the sturgeon) the transition from the spinal column to the skull is so gradual that the two are difficult to distinguish. In the Silurian fish *Bagrus* (as Owen pointed out) the vertebræ next the head are greatly expanded, and join each other by suture, and this shows how undoubted vertebræ may simulate osseous cranial walls.

It is true that, unlike the nascent spinal column, the primitive skull presents no serial segmentation, and that the cartilaginous precursors of the cranial bones may even be divided medianly and antero-posteriorly. Nevertheless, in the young axolotl, before the base of the skull has become cartilaginous, an index of transverse segmentation is to be traced in the soft tissue of that region, in spite of the subsequent continuous chondrification of the base of the skull.

But most striking of all is the return made[9] of late years by Sir Richard Owen's main opponent to the conception that serial segmentation, however latent and disguised, extended primitively and fundamentally to quite the anterior end of the head, and that, judging from *Amphioxus*, the skull of the higher vertebrates may be represented as made up of something less than twenty serial segments, each of which is equivalent to a spinal vertebra with its annexed parts.

The conception of cranial vertebræ, then, like the conceptions of serial, lateral, and general homology, are subjective apprehensions of relations having an objective existence in nature. They are like conception "types," which are not, of course, real objective entities, *as types*, though they are conceptions which have none the less an objective basis. The acceptance of the theory of evolution is no bar to the reception of the view which represents all organic forms

[9] Proc. Roy. Soc., no. 157, p. 127.

as having been specially created according to certain fixed and pre-ordained ideal types. The two beliefs, far from being reciprocally exclusive, can and do exist in perfect harmony.

Immediately underlying the question here touched upon reposes one of the deepest and most important of all philosophical questions, but we have no space to enter upon its consideration here. Profoundly impressed as we are, however, with the significance of questions touching philosophical anatomy, we cannot refrain from expressing our sense of the deep gratitude the world owes to Sir Richard Owen, who, years ago, forced questions such as these upon willing and unwilling ears. The details of his system are erroneous, much of it is fanciful and baseless. But he has nevertheless enriched zoology with a knowledge of a multitude of valuable facts, and many of his memoirs are models for those who come after him. To not a few kindnesses, and to many worthy actions, unknown to the world, we can testify. Of him, at least, it can never be said that he sought eminence through the degradation of his species, or that with selfish recklessness he threw broadcast seeds producing fruits fatally poisonous to all that is highest and best in man, or that gives any virtue, beauty, and dignity to human life. His work is done, his troubles, his labours, and disappointments are over. May his end bring him peace.

ST. GEORGE MIVART.

III.—SIR RICHARD OWEN'S RESEARCHES ON THE INVERTEBRATA.

IN the course of more than half a century's active devotion to scientific research, Sir Richard Owen has investigated the structure of almost every group of living and fossil organisms from man to the internal parasites affecting his frame. His contributions to knowledge of the invertebrated animals are not so numerous as his publications on the living and extinct forms of the vertebrata, but his attention was nevertheless directed successfully in early life to this interesting division of the animal kingdom, and his original memoir on the Pearly Nautilus, published in 1832, when he was only twenty-seven years of age, laid the foundation of his well-deserved fame as a physiological anatomist. Just twelve years later he was awarded the Copley Medal of the Royal Society, in recognition of the merits of a memoir on the fossil "Belemnites" published in the Philosophical Transactions.[10]

The general results of Professor Owen's investigations of the Invertebrata were epitomised in his Catalogues of the Fossil Invertebrata in the Museum of the Royal College of Surgeons, in which more than three hundred and fifty species of fossil cephalopoda collected in the previous century by his famous predecessor in office, John Hunter,

[10] In conjunction with the Memoir on the Monotreme Mammalia.

were described; in Lectures on the Comparative Anatomy of the Invertebrata, largely based on discourses delivered during his occupancy of the "Hunterian Chair," in that great institution, the foster-parent of so many distinguished reputations; in an article on Cephalopoda contributed to the "Encyclopædia of Anatomy and Physiology," and in that on the Mollusca, including the Molluscoidea, to the eighth edition of the "Encyclopedia Britannica." A remarkable article, entitled "Palæontology" was first published in the latter work, and subsequently enlarged and re-issued as a "Systematic Summary of Extinct Animals and their Geological Relations" in 1861 as a separate publication. (Part I., relating to Invertebrata.) This is one of the best examples of Professor Owen's literary powers of popular exposition of technical details. The Memoir on "Parthenogenesis," treating of the phenomena of asexual generation among certain groups of Invertebrates, belongs more properly to the category of his speculative and philosophical inquiries.

We will now refer briefly to some of the most important of Professor Owen's publications on invertebrates, grouping them for convenience more in zoological order than chronological sequence. Observations on the structure of a new genus of "well-woven" sponge *Euplectella aspergillum*, Owen, appeared in 1841; and in 1857 a new species of the same interesting genus was described. "The threads of the *Euplectella* were not first spun and then interwoven," he wrote in his second memoir on the genus, "but were formed as interwoven, the two processes going on simultaneously; or *pari passu*, in the living state, the exquisite structure of the flinty framework may be veiled by the delicate, gelatinous, enveloping, organic tissue."

No less than five memoirs on the Entozoa appeared in the first volume of the Transactions of the Zoological Society issued in 1836, and his comprehension of "the structural differences existing among them" induced him to propose a more natural classification of this difficult group. His descriptions and figures of a new endo-parasite, first discovered by Mr. (now Sir) James Paget, his fellow student, at St. Bartholomew's Hospital, infesting the voluntary muscles of a human subject, and the subsequent recognition by Zenkrer of *Trichina spiralis*, Owen, as the cause of a troublesome and often fatal disease now known as Trichinosis, led to results of practical utility to mankind.

An interesting paper, entitled *Protichnites*, was published in 1852, wherein the fossil footprints of ancient crustaceans were tracked in the sands of time. "Old Nature speaks as plainly as she can do by these distinct symbols, and if we do not fully thereby read her meaning, the fault is in our powers of interpretation. The creatures which have left their impressions on the most ancient of known sea shores belonged to an articulate and probably crustaceous genus, and *Limulus* comes the nearest to my idea of the kind of animal which has left the impressions on the Potsdam Sandstones."

Twenty-one years later Professor Owen published an elaborate and well-illustrated memoir on that interesting, abnormal, but mis-named arthropod, the King-Crab (*Limulus polyphæmus*), which is no crab, and has since been definitely promoted out of the class of water-breathing Crustacea into that of the air-breathing Arachnida and associated with the Spiders and Scorpions.[11] He detailed the muscular, nervous, digestive, and generative systems, and proposed the term "Cephaletron" for the anterior division of the body, and "Thorocetron" for the second; while he declared "the chief fossorial agent, as indicated by the size and disposition of the principal muscular masses, to be the cephaletral digging-shield." While recognising some of the Arachnid affinities of the King-Crab as then maintained by Strauss-Durckeim and Latreille, Owen did not admit the necessity for removing the genus from the order of Merostomatous Crustaceans.

Professor Owen's numerous memoirs on the anatomy of the Brachiopoda were second only in importance to his researches on the Cephalopoda. In both classes he founded orders which have been generally[12] accepted by biologists, and still maintain their position as recognised additions to zoological nomenclature and classification. In the article on "Mollusca," published in the eighth edition of the "Encyclopedia Britannica," the sub-kingdom Mollusca was divided into the *Heterogangliata*, with one nerve ganglion, and the superior *Homogangliata* of Owen. The group was compared to a tree, with the Cephalopoda at the summit, one of the roots appeared to be lost in the Turbellarian and the Trematode families of Abranchiate Vermes; the Brachiopoda conducted to the Bryozoa, and both, with the Tunicata, were considered as "mollusc-like" rather than molluscan. The Brachiopoda were regarded as a class equivalent in value to the Lamellibranchiata, and were placed between those acephalous molluscs and the sea-squirts, that is to say, between the "Acéphales testacées," and the "Acéphales sans coquilles" of Cuvier. In 1833 the anatomy of the "Cuvierian genera of Brachiopoda," more especially of *Terebratella* and *Orbicula* (now known as *Discina*), were described. The circulatory, muscular, and nervous systems of other genera were more fully investigated twenty years later, and the results published, accompanied by beautiful drawings by the author, in a "Memoir on the Anatomy of Terebratula," in the Introduction to Davidson's classical Monograph of the "British Fossil Brachiopoda," elucidating some points in the structure of *Waldheimia* and *Lingula*. Owen's brachiopodal hearts are now known

[11] "Limulus an Arachnid," by E. Ray Lankester, F.R.S. *Quart. Journ. Micros. Sci.*, 1881.

[12] Waagen and F. A. Bather excepted. Mr. A. H. Foord, in his exhaustive "Catalogue of the Fossil Cephalopoda in the British Museum," 1888 (p. viii., Int., part i., Order Nautiloidea), states that "no evidence has as yet been brought forward that the fossil forms included by Owen in the Tetrabranchiata were other than four-gilled."

to be oviducts, and it has since been made evident that he did not recognise the closure of the intestine in certain genera—a physiological feature of ordinal value. But he divided the class into two orders, so well differentiated by other characters, that the names of *Lyopomata* (or loose valves) and *Arthropomata* (or jointed valves), which he applied to them respectively, should retain priority over the *Articulata* and *Inarticulata*, the *Tretenterata* and *Clistenterata* of other investigators, of which subdivisions they are the exact equivalents. Owen's researches on the internal structure of the Brachiopoda marked a distinct advance in knowledge of this difficult and obscure group of organisms.

In a memoir on the anatomy of *Clavagella*, Professor Owen noted the enormous development of the mantle in the "club shells" as one of the instruments in the work of excavation for which these bivalves are remarkable. Some observations on the camerated structure in the valves of the water-clam (*Spondylus varius*) were first printed in the *Proceedings of the Zoological Society* for 1837, when attention was directed to the chambered and septated condition of the shell in that genus, and to the connection existing between the mode of growth in *Nautilus* and that of other molluscs which partition off a part of their shell not required for the convenience of the soft parts of the animal inhabiting it. It was then distinctly stated that the septal divisions of the *Nautilus* shell are analogous to the septa of the "water-spondylus," and many other shells which partition off the disused portion of their houses both among univalves and bivalves. An investigation of the anatomy of the gasteropod family of the "bonnet-shells" (Calyptreidæ) proved of interest "as manifesting some of the successive stages of complexity in the passage from the simple *Patella* to the spiral valves." Professor Owen's studies of the univalve mollusca in general, and of the recent *Nautilus* in particular, led him to the conclusion that the Pteropoda had less affinities with the Dibranchiate, or "two-gilled" cephalopoda, than the recent *Nautilus*. This form he considered to be the type of an inferior order of tetrabranchiate, or "four-gilled" cephalopoda, represented by numerous fossil species, and as an osculant form between the cephalopoda and gasteropoda. In consequence of this conviction, he transferred the encephalous floating Pteropoda from above to below the Gasteropoda[13] in his classification of the Mollusca, which is based chiefly on the conditions of the respiratory organs, as a physiological character intimately connected with activity of locomotive functions.

The subject of the Pearly Nautilus had been strongly recommended to his attention by Baron Cuvier, in whose dissecting rooms young Owen enjoyed the privilege of working. The famous French zoologist had never seen a specimen of the animal of this genus,

[13] The Pteropoda are now considered to belong to the inferior branch of the class Cephalopoda by those who place the class Gasteropoda at the summit of the Molluscan series.

which was known to Aristotle, and had been briefly described by Rumphius. It was, therefore, with peculiar satisfaction that Mr. Owen received an example in alcohol which had been captured, in a dying condition, by his friend and former fellow-student at the College of Surgeons, Dr. George Bennett of Sydney, while cruising in the Polynesian seas. The results of his investigations appeared in the "Memoir on the Pearly Nautilus, with illustrations of its external form and internal structure," which, to the keen regret of the author, was not issued from the press until three days after the death of his illustrious master. The animal was shown to be characterised by the presence of pedunculated eyes, calcareous mandibles, like a bird's beak reversed, a crop, gizzard, and liver, four gills, or breathing organs, and by the absence of a branchial heart and ink-bag. It occupied the last and largest chamber of a nacro-porcellanous, many-chambered shell, into the last cell of which it could retract itself and its numerous simple non-aceptabulated arms closing the mouth of the shell by the dorsal arms and by a horny hood-shaped structure, the analogue of the aptychi or double operculum of the fossil Ammonite. A central siphuncular tube pierced all the septa running through all the chambers or so-called "air-cells" which had been occupied by the animal in succession. This siphuncle "subserved a hydrostatic function," enabling the animal to rise to the surface and sink to the bottom, possibly by means of a gas secreted from the mantle. But the author's remark that "much remains to be done before the theory of the chambers and siphuncle can rest on the sound basis of experiment and observation" is still applicable.[14] The order Tetrabranchiata was proposed to receive the recent *Nautilus* characterised by the presence of four gills, a many-chambered external shell, and the absence of an ink-bag; and the fossil Ammonites and their allies were included therein. The Dibranchiata comprised all the two-gilled naked Cephalopods with an internal shell, or pen, and an ink-bag such as the living octopoda, the squids, cuttles, and the fossil Belemnitidæ.

In 1844 Professor Owen resumed the study of fossil cephalopoda, and communicated descriptions and figures of "certain Belemnites preserved with a great proportion of their soft parts in the Oxford Clay at Christian Malford, Wilts." The guard sheath or rostrum, known as the dart or javelin, whence the name Belemnite was originally applied, was described; the chambered or vertically septated portion was named the phragmacone; while the presence of an ink-bag, internal shell, muscular mantle, and aceptabulated arms were duly noted, and the fossil molluscs were classed with the recent

[14] There appears to be no doubt that the deserted chambers of the *Nautilus*-shell contain, in the healthy living animal, a gas which serves to lessen the specific gravity of the whole organism. . . . "A certain stage is reached when no new chamber is formed; with regard to its origin we can only conjecture; the whole matter is involved in obscurity." Ray Lankester, ninth ed., Ency. Brit., 1883.

Spirula, in the order Dibranchiata. The examples of *Belemnites oweni* upon which this memoir was founded, were subsequently shown by later investigators to belong to the animal of *Belemnoteuthis*, an extinct member of the existing squid family, and the animal of the true Belemnite proved to be characterised by the presence of an internal pen or pro-ostracum not found associated with the fossil remains of *Belemnoteuthis*.

In the same year Professor Owen communicated to the Zoological section of the British Association two papers detailing the "Further Experiments and Observations on the *Argonauto argo*," by Madame Jeannette Power, the originator of marine aquaria. He prefaced them with some remarks on the relation of the animal of the Paper Nautilus to its shell. The experiments which proved that the dorsal arms were the fabricants of the shell instead of the mantle, as in the Pearly Nautilus, had been suggested to Madame Power by Professor Owen. He has also described *Rossia*, a sub-genus of *Sepiola* (*R. palpebrosa*, Owen). In 1848 he enjoyed an opportunity of dissecting an unique but fragmentary specimen of the animal of *Spirula peronii*, and a portion of *Spirula reticulata*, and contributed the results to the "Zoology" of the "Voyage of H.M.S. 'Samarang.'" Thirty years later he returned to the subject of the structure of this interesting genus.

In 1878 Professor Owen discussed with much vigour "The Relative Positions to their Constructors of the Chambered Shells of Cephalopods." In this paper he showed that the shells of *Nautilus* and ammonites are revolutely spiral, or coiled over the back of the animal, not involute like the *Spirula*, and maintained the opercular character of the aptychi, which had been doubted by Keferstein and Waagen. He reiterated the opinion that they correspond to the fibrous hood of *Nautilus pompilius*, and are the calcifications of an ammonite hood. The fact that no trace of the ink-bag has ever been found with any fossil ammonite although that organ occurs abundantly in the fossil Belemnitidæ, is cited as conclusive evidence that the Ammonites were tetrabranchiates protected by an external shell, and he points out that the occurrence of the protective ink-bag in the *Spirula* proves that mollusc to belong to the more active dibranchiate order, with an internal chambered shell—the homologue of the phragmacone of the Belemnite.

The ink-bag does not occupy the last chamber of *Spirula*, as had been maintained in Woodward's "Manual of the Mollusca." The situation of the small pyriform ink-bag in that genus being "rectal," as Owen first demonstrated in 1848. It is denied that the septated condition of the many-chambered shells of the *Nautilus* was related conditionally to the generative function and periodical increase, as had been asserted by Professor Seeley and by Dr. Henry Woodward, for the reason that the formation of such chambers commences from the embryonal cup ("protoconch") and continues through an early

period of growth antecedent to the acquisition of the procreative functions, or the adult stage of existence, and that these early chambers are relatively deeper than the succeeding ones.

In this comprehensive review of the subject Professor Owen states that he "holds by the opinion expressed in his original memoir and in the 'Catalogue of the Fossil Cephalopoda in the Hunterian Museum' (4th ed., 1856, p. 29), that they so affect the specific gravity of the active, highly-organised, cephalopodous mollusc, as to enable it with little èffort to rise, in the case of the *Nautilus*, from its habitual position at the bottom of the sea, and in the case of the *Spirula*, to sink from its more usual zone at or near the surface, by means of the hydrostatic mechanism worked by the muscular forces of the mantle and funnel. The constancy of the siphuncular connection running through all the chambers of the largest and most complex of the polythalamous shells, with the great size and singular complexity of the siphuncle in several extinct species, form the grounds on which I still hold to my original belief in the function of the siphuncle as related to a maintenance of the vitality of the shell."

In the following year, Professor Owen published the results of his dissections of a perfect specimen of *Spirula australis* received from Mr. Cuming. The animal was described as almost as devoid of external organs of natation as *Nautilus*. In both, the direction in which such forces act is retrograde. *Nautilus* exercises them mainly by virtue of the muscular funnel, through which it forcibly ejects into the surrounding water the respiratory current. *Spirula* superadds to this the ejection of that volume of water upon which the cephalic arms and their basal webs contract after the fashion in which the other Dibranchiata, especially the Octopods, propel themselves backwards. *Spirula* is superior to *Nautilus* in the cephalic mechanism. In both instances of multilocular cephalopods, the natatory power is inferior to that of existing Dibranchiata. The distinction, therefore, between *Nautilus* and *Spirula* in regard to the shell in its protective relation is relative not absolute: in the one a small proportion of the shell is occasionally "internal," in the other a small proportion is always "external," in both the multilocular shells correspond with the phragmacone of the Belemnite. The tetrabranchiate *Orthoceras* may be called a representative analogue of the dibranchiate Belemnite, as the tetrabranchiate Ammonite is of the dibranchiate *Spirula*. The siphon is "ventral" and marginal in both kinds of coiled shells, but it runs along opposite sides of the coil. In *Spirula*, its position is internal, or ento-marginal; in ammonites, it is external or "ecto-marginal."

In 1883 the veteran anatomist published a paper on the "Aspect of the body in Vertebrates and Invertebrates," which formed, we believe, his last contribution to the anatomy of the invertebrated animals. His researches cover a period of fifty years and afford

constant proof of the patience, industry, and acumen of the author. "The progress of Palæontology since 1830," he wrote in 1866, "has brought to light many missing links unknown to the founder of the science. My own share in the labour led me, after a few years of research, to discern what I believed, and still hold to be, a tendency to a more generalised or less specialised organisation as species recede in date of existence from the present time."

AGNES CRANE.

(To be continued next month by an account of Sir Richard Owen's Researches on the Vertebrata.)

II.

Artificial Protoplasm.[1]

LET it be said at once, for the benefit of the timid, that Professor Bütschli does not claim to have made protoplasm. His sumptuous quarto contains the results of ten years' special work on the physical side of the phenomena of life. The author is very strongly opposed to that school of Biologists who attempt to surround the phenomena of life with unnecessary mystery, and who clamour at once timidly and virulently against all physical and chemical interpretations. He has now been able to make microscopic foams which in structure and behaviour, under various conditions, marvellously resemble the structure and behaviour of protoplasm. These foams have enabled him to bring together the observations of himself and others on the actual structure of protoplasm, and to furnish a striking theory of its physical nature.

He tells us that he began his attempts at the making of foams with the forlorn feelings of a nineteenth century alchemist. The starting point was this: If fine particles of a substance soluble in water be mixed with a fatty oil, and the mixture be placed in water, the water diffusing into the oil becomes arranged in minute droplets round the particles of soluble material, and a foam is formed. Owing to the difficulty of breaking up the soluble substance into sufficiently minute particles, the particles, viewed under the microscope, are very coarse. The drops are placed on the under side of a coverslip with wax feet, and the coverslip is placed in a drop of water on a slide. When such a slide is put in a damp chamber for about 24 hours, the drop becomes quite milky and opaque. When it is flattened out by pressing on the coverslip, or made transparent by allowing glycerine to diffuse through it, this drop shows that it is composed of a very fine froth. It seems probable that the froth is caused by the presence in the oil of a small quantity of soap. The soap is more soluble in water, and the solution of soap and water has gradually separated out in very fine droplets. Bütschli empirically found the best way to produce these froths. Fresh olive

[1] UNTERSUCHUNGEN UEBER MIKROSKOPISCHE SCHAEUME UND DAS PROTOPLASMA. By O. Bütschli. (With 6 lithographic tables, and 23 figures in the text.) Leipzig: Engelmann, 1892. Price 24 marks.

oil must be kept in a watch glass, at a temperature of from 50–60° Centigrade, for twelve days, or at 80° C. for about three days. It becomes nearly colourless, and rather thicker. This is placed in a mortar, and powdered, but not anhydrous, carbonate of potash is rubbed into it. Although the desired result is the formation of a soap in the oil, good froths are not obtained by adding fatty acids or soaps to the oil.

The prepared froths, then, consist of a multitude of tiny droplets of a solution of soap in water, each droplet being surrounded by a film of liquid oil. The films, when they are in contact, naturally run together, and so a structure of polyhedral figures is built up, just as when one blows into soap solution in a saucer, the mass of bubbles can be seen to consist of polygonal figures. Minute examination of the froth-structure shows that at the nodes where the films meet, owing to their liquid condition, slight expansions occur (*op. cit.*, p. 20, Fig. 2). These expansions, when the bubbles are very small, give a granular appearance to the whole structure—an appearance which is more striking when a part of the froth more than one layer of bubbles thick is examined. The general optical effect is that of a meshwork, with thickenings at

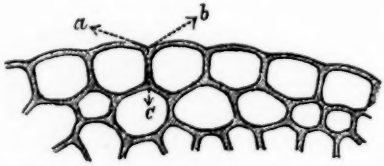

FIG. 1.—Foam under high magnification showing reticulate and fibrillar appearance and nodes.

the nodes. Bütschli found that when adventitious particles as, for instance, of lamp-black, are mixed with froth, these particles tend to collect at the nodes; but a careful study of the froth shows that node thickenings alone are enough to account for the granular appearance of protoplasm. He also shows how the familiar fibrillar, reticulate, and lamellar appearances, on careful focussing, are resolved into arrangements of bubbles.

He shows and explains, theoretically, how surface tensions make drops of such a froth, suspended in a liquid, assume a globular form, save under the influence of special internal or external forces. For some not very clear reason, the larger bubbles come to group themselves in the interior of each drop. Round the periphery, where the surface tensions are similar, a single row of bubbles of equal size becomes arranged (Fig. 1). The films separating these bubbles are radially arranged, and so there is formed a definite alveolar border. When the bubbles are small, this looks like a striated border. A similar border is naturally formed round any internal large vacuole. The alveolar layer, spite its definite appearance, remains as liquid as the rest of the foam, and persists while the drop is flowing.

These drops show very remarkable streaming movements. While they are in a weak solution of carbonate of potash they remain at rest. But this solution may be removed by drawing pure water under the coverslip on its wax feet by means of pieces of filter paper. Thereupon the drops, if they are not pressed on by the coverslip, move about actively. During this movement they may change in shape, the change consisting in the extrusion of processes of the foam in the direction of the movement. The internal streaming movements can be seen when the opaque drops are cleared by glycerine. It consists of an axial stream from the centre of the drop to the edge in the direction of the movement through the liquid of the whole foam. At the edge the stream turns back over the surface of the drop, and the backward streams so formed join the axial stream posteriorly. All this corresponds very closely with the streams and motion of a simple amœba. After a time the streaming from one centre ceases, a new set of currents form from a new centre,

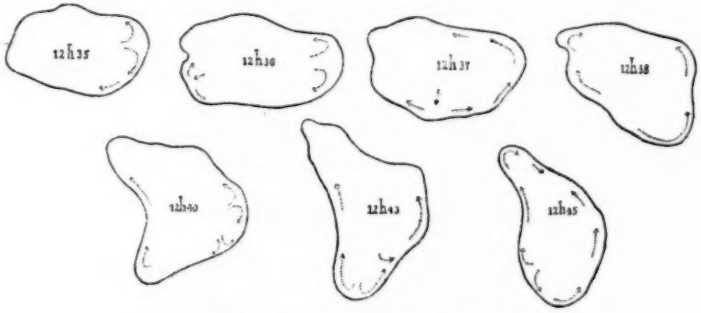

FIG. 2.—Figures of streaming movements observed in a drop.

and movement in a different direction occurs. Sometimes several centres of streaming are present together, and the whole drop excessively resembles an amœba. The streaming goes on from 24 hours to at most six days (Fig. 2).

The theoretical explanation of these movements depends on surface tensions. When a liquid is brought towards a drop of a second liquid suspended in a third, if the surface tension is less between the first and second than between the second and third, as the first liquid approaches the second the drop of the second stretches out towards the first, and a set of streaming movements occurs. Thus, in the figure some soap solution (first liquid) is brought up towards a drop of oil (second liquid) suspended in water (third liquid). Then the drop of oil moves gradually into the soap solution, and the currents shown by arrows in the figure appear (Fig. 3). The surface tension between the oil and soap solution is less than the surface tension between the oil and water. The equilibrium is destroyed and the soap solution spreads round on the drop from the

point of contact. As it passes round it gets more and more diluted, and the equilibrium continues to be disturbed. The surrounding fluid presses in to replace the soap solution, which is carried backwards from the point of contact, and this general pressure, acting alike on oil, soap, and water, moves up the oil drop slowly towards the point of contact with the soap solution.

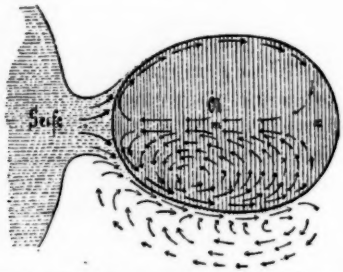

FIG. 3.—Soap solution (*seife*) in contact with drop of oil (*ol*) suspended in water, showing streaming movements.

In the actual case of the froths, the soap solution is contained in the cells of which the froth is composed. Centres of streaming movements are produced by the soap solution diffusing out into the surrounding liquid or by the bursting of superficial cells.

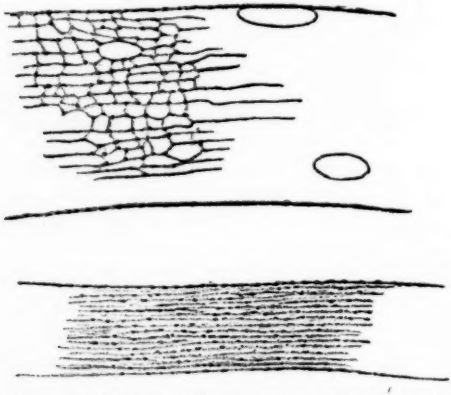

FIG. 4.—Foam of olive oil and carbonate of potassium, very viscous, much magnified, and pressed into fibrils by the cover glass. The upper figure is a higher magnification of part of the lower figure.

From a consideration of these froths Professor Bütschli passes to the observed appearances of actual protoplasm in the animal and vegetable kingdom, and from a large number of instances collected from all manner of cells, he shows how readily these appearances can be interpreted if we suppose protoplasm to have a frothy structure like the structure of his artificial drops. Of these two instances are reproduced opposite.

A large part of the remainder of the book is occupied by a discussion of various existing theories of the structure of protoplasm, and it concludes by foreshadowing possible explanations of various phenomena like the streaming movements in plant cells, and muscular contraction, upon the basis of his interpretation of the structure of protoplasm.

Put generally, Professor Bütschli's results are these: Protoplasm is itself a special chemical substance, the seat of many chemical changes. But it is also a physical substance, with definite physical texture, and obeying definite physical laws. It is possible to construct foams of different chemical nature but with similar physical properties. These foams show that protoplasm is composed not of a network containing sap and granules, but of a series of delicate bubbles obeying the physical conditions that rule bubble structures. The contents of the bubbles are some kind of fluid—a fluid which can be replaced by glycerine and other reagents. Many of the familiar features in

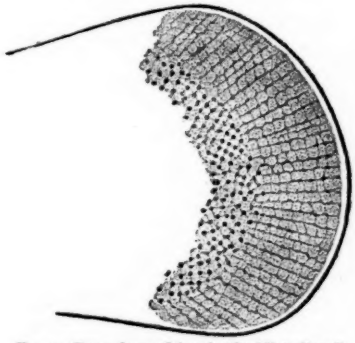

FIG. 5.—Protoplasm of *Amœba* (*Cochliopodium*?) *actinophora*.

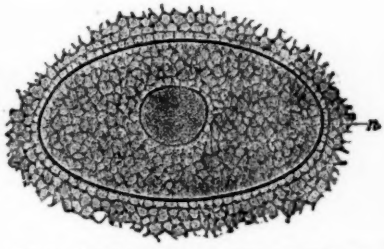

FIG. 6.—Nucleus with part of surrounding plasma from gangliar cell of ox.

the microscopic appearance of protoplasm—features like the network, the granular and fibrillar appearances, the striated alveolar layers, are the optical expression of this frothy structure.

Streaming movements, changes of shape, progression through fluids, are physical conditions. In artificial froths they can be referred easily to differences in surface tension inside the froth and between the froth and the surrounding fluid. The more complex chemical conditions and the active chemical changes in protoplasm render it highly probable that complicated changes of tensions within and without the cell are constantly being produced, and so there is to be expected a more lifely manifestation of the movements of streaming, of change of position and change of shape, which are actually present in the relatively simple artificial froths. A combination of fuller knowledge of the chemistry of protoplasm, combined with this fuller knowledge of its physical structure, would go far, if not the whole way, to an understanding of life.

This must suffice for a short account of the nature of Professor Bütschli's investigations. I am glad to be able to say that my friend Mr. E. A. Minchin has arranged with the author and publisher for the production of an English translation of this work. Until the appearance of this, everyone who can spare time to cope with an intricate and rather perplexing German style should go to the original. Vitalism, the empirical study of living organisms as living, may be the most presently fertile working hypothesis. But only those of little hope look for no final synthesis of the facts of Biology, Physics, and Chemistry, and even now they will have much ado when they try to discount Professor Bütschli's brilliant work.

P. CHALMERS MITCHELL.

IV.

Phases of Evolution in the Guiana Forest.

THE great forest region of South America, which extends almost to the shores of British Guiana, is one of the most interesting in the world to the naturalist. An ordinary observer may, perhaps, think its dark arches tame and dull, but even he is delighted with the beauty and variety conspicuous at every bend of a creek or on the edges of the savannah. Unlike the woods of Europe, so uniform in character, we have here trees of a hundred species struggling with each other for position, or straining their utmost to hold their own in the great battle for life. It is hard to find two individuals of the same species growing together; each appears to be fighting for himself, regardless of the others, whether akin or not.

As a result of this, specialisation is a most prominent characteristic, not only of genera and species, but even of individuals. The oaks and pines of temperate climates are undoubtedly variable to a considerable extent, but will not compare with the great family of Leguminosæ in the tropical forest, where a thousand contrivances are manifest in trunk, leaf, flower, and fruit. The different forms of the legumen alone are particularly interesting. Here we have the trysil (*Pentaclethra filamentosa*) with pods a foot long, and, farther on, the wallaba (*Eperua falcata*), which hangs its scimitar-shaped fruit on long strings. Then the tonka-bean with plum-like fruit, the arisaro and others with winged seed-vessels, and a host of shrubs and climbers with pods so curious and wonderful as to baffle the naturalist when he attempts to find reasons for their existence. Other natural orders, such as the Lecythideæ and Lauraceæ are also particularly interesting.

At first the wealth of species is almost bewildering; the forest alone would give work for a lifetime. It is so grand and magnificent —so crowded with immense trees, bush ropes, epiphytes, and parasites—so varied in species, as first to excite enthusiasm and then depress with the thought that life is too short to investigate it thoroughly.

Coming from a temperate climate, where the number of species in a wood can be counted on his fingers, the European sees above him a canopy of intermingled branches and foliage of a hundred different kinds which he cannot even reach, much less identify.

Nothing but an interminable assemblage of columns and a green roof above is seen, and even these but indistinctly, as not a ray of sunlight can penetrate the canopy.

On the ground the soil is covered with fallen leaves in various stages of decomposition, some already sunk into the rich brown humus so characteristic of the forest, others still retaining their shapes, and a few, newly fallen, mingled with petals and perhaps monkey-pots, pods, or other fruits. In one place the ground is covered with petals and the botanist turns to look for the tree from whence they have fallen, or even takes out his glass—but all in vain, for no particular tree can be separated from the throng; the flowers are outside in the light, and quite invisible from below.

Only on the edge of the forest, where it borders on the river or savannah, can the trees be identified. Here a mass of yellow shows that an etabally (*Vochysia*) or some leguminous tree is flowering, but it is almost impossible to procure a specimen. When the tree rises sixty or eighty feet without a branch, nothing less than cutting it down will serve. A few broken spikes may be brought down by a shot, or, perhaps, if the traveller is fortunate, one of his Indian boatmen may cut off a branch with an arrow, but to do either he must be fortunate indeed. True, many a specimen may be gathered alongside the river or creek, but some of the great forest giants are not found in such a situation. Even the mora (*Mora excelsa*), which is so common, hangs its flower spikes far overhead in a most tantalising manner, as if defying the botanist to gather them. With so few outside enemies, the trees of the forest have only to contend with each other for their shares of the light and moisture. Hardly a single ray can reach the ground. On the banks of the rivers where the continuity is broken, hosts of epiphytes crowd the great limbs and branches, utilising the diffused light. Seated on the upper sides, they extend outwards and downwards until they almost form curtains. Even those which grow upright often push their flower-spikes from the side or base so that they may gather more light away from the crowd. Ferns and orchids have developed this faculty to its greatest extent, hanging their long leaves straight downwards until they sometimes touch the points of other plants on the branch below.

If these do not take up every ray, a jungle of palms, tree-ferns, marantas, and arums crowd together underneath, along the rive banks, and prevent all access to the forest except by cutting a way through them. If the river-current is strong, no water plants can secure a footing, but in every creek there are bays where, given a little sunlight, patches of *Cabomba aquatica*, or water lilies, manage to exist.

The atmosphere inside the forest is hot, dense, and steamy. To the old colonist it suggests intermittent fever, but to the naturalist its peculiar odour recalls many a pleasant journey through creek and wallaba swamp, or, perhaps, remembrances of anxious hours when

he found himself lost in the forest. The perspiration streams from the new-comer, and unless he is enthusiastic in pursuit of his hobby he is glad to find himself again on the river. Where the land is low, pools of ruddy-brown water occupy the hollows between the immense buttresses of every tree, while here and there small streams wind in and out among them. The fallen leaves and other *débris* form an oozy kind of peat, obviously giving colour to the water, which is the same in almost every creek and river in Guiana.

It is generally considered that the forest is unhealthy for man. Residents along river banks suffer more or less from intermittent fevers, which often leave them after a change to the coast. In opening up new land by clearing, it is notorious that strangers suffer much while the work is going on. Swamps are also unhealthy for strange plants. Few cultivated fruit trees can endure inundations for even a day or two. Yet, under these conditions, the trees of the forest thrive. They have obviously become accustomed to environment such as would be dangerous to nearly all others. Is it not possible that what is dangerous to a plant is just as injurious to man, unless he has protected himself in some way? Also that there may be lessons to learn from the way trees have warded off the danger?

It is an undoubted fact that the forest giants of Guiana have evolved contrivances to prevent the development of low fungi. The most common of these is a thick bark containing tannin. This tannin is Nature's great antiseptic. It is found in all the waters of the forest and swamp, and accounts for that great difference which exists between the clear brown bog water and that seat of infection the stagnant pool. In towns and villages ordinary rain-water, if allowed to remain in open trenches, never resembles in its antiseptic properties that of the forest. The Indian has gone to the forest and learnt a lesson. When suffering from ulcers he scrapes the inner bark of some tree and applies it to the sore with most beneficial results.

Besides this, many other secretions have been developed. One of the most extraordinary is, perhaps, the milky juice which dries into india-rubber and gutta-percha. It is well-known that the Hevea grows only in places that are periodically inundated, and this characteristic is also strikingly exemplified in the tree which produces balatta, the gutta-percha of Guiana. It may be objected that some of the species of *Ficus*, which have similar juices, do not necessarily belong to the swamp, but perhaps their ancestors lived under different conditions. These secretions are so evidently fitted for protection against water that we can hardly conceive of them in any other connection.

Then there is another large class, the gum-resins and oleo-resins, also common in Guiana. Gum animi, the incense gum from the hyawa *(Icica)*, and balsam copaiba are the best known examples. The species of *Copaifera* are characterised by their thick bark, from which the Indian wood-skin canoes are made, and which are preserved

for a long period by their impregnation with the balsam. The tree which, perhaps, above all others delights in the inundations of the forest is the wallaba. In this we have not only a secretion of tannin, but also an oleo-resin which impregnates the tree to its very heart. Others have similar balsams, while some are so impregnated with essential oils as to smell quite strong, although not always pleasant. These secretions make the Guiana timbers so valuable, as they endure longer under water than those from any other part of the world.

Bitter extractives are found in the barks and seeds of many trees. Simaruba and greenheart are well-known, as they may be found in the British Pharmacopœa. No doubt they are also protective, perhaps chemically. Is it not possible that there is some truth in the old belief that medicines grow in every country suited to the disorders endemic to the place? The true explanation of this would be that plants protect themselves against evils which also affect man, and he, going to nature for a lesson, learns to follow their example.

Protected against floods and excessive dampness by so many contrivances, the forest trees are able to secure moisture at all times without suffering from drought or flood. With such a wealth of rotting leaves about their roots, there is never any lack of plant food, and as for light, they have to struggle hard for that. In doing this we cannot help seeing that they are intensely selfish. We can hardly conceive of selfishness without a self—an individual—and that every tree, and even the humblest plant, is such the naturalist is bound to admit. No matter that he cannot recognise one from another except in but few instances, the individuality is there and has been working for ages to raise the species to its present stage. According to the amount of individuality so will progress be greater or less. Heredity and environment may account for a great deal, but there is always something more than inherited traits and force of circumstances. Evolutionists have apparently thought too much of species and too little of individuals. At some time or other the individual was father to the species, and a few of the present generation may be progenitors of new forms, the careful observation of which will give the naturalist of the future the strongest proofs of evolution.

The tropical forest is undoubtedly made up of individuals. There is little of that apparent unison so common in temperate climates, where the trees open their leaf- and flower-buds together and at regular seasons. Here the ordinary observer says there are no seasons, but that trees flower and fruit all the year round. This, however, is an exaggerated statement not borne out by facts. There are two cycles in a year, the first in British Guiana commencing in February, and the second in August. As might naturally be expected, some species and varieties are earlier or later, and not only is this the case, but hardly two individuals flower, fruit, or drop their leaves at exactly the same time. This is most strikingly exemplified in the mango and other cultivated fruit trees. At the

present time (September) the mango has been flowering for two months, and trees may be seen in different stages from unopened flower buds to half-grown fruit. The fruit will ripen from December to February, when the great mango-season will be over, and only a fruit here and there be obtainable until June and July, when a second crop matures. The result of the two cycles and the difference in flowering and fruiting of individual trees is that most tropical fruits are obtainable more or less for six to eight months of the year, being, however, far more plentiful during the few weeks of each season when the majority ripen.

It is hardly necessary to bring evidence in favour of individuality among cultivated plants. Every gardener and florist knows that it is impossible to predict absolute uniformity in the offspring of a single plant, even when the greatest care is taken to prevent crossing. Everything goes to prove that the same individuality can be found, more or less, throughout the plant world, but it is especially recognisable in tropical plants. The analyst notes differences in the amount of active principle in samples of drugs, the tanner in barks, while the wood-cutter accounts for one log being more durable than another by false notions of the moon's influence.

Leaving the trees of the forest, which are so difficult to investigate particularly, and coming to the epiphytes which grow upon them, we find specialisation carried to extremes in the great orchid family. The collector, the dealer, and the grower will all admit individuality here. The varieties are so numerous as to be almost impossible to define. Not only are there differences between plants of the same species from several localities, but even among those collected within a small area. Any grower who knows his plants will recognise one from another, and be continually on the look-out when each flowers for the first time. On account of these differences, orchid collecting is particularly fascinating. A dozen plants of one species are bought at auction, and, until they flower, no one can tell how they will turn out. We often hear of unique specimens, but the fact of the matter is every one is unique.

In the case of the orchids, there can be no suspicion of man's interference. Artificial selection may have been concerned in the development of other families, but not of this. The wonderful variations in the leaves of crotons and flowers of the hibiscus family may, perhaps, be due, to some extent, to their appreciation by the Polynesians, but the Indians of Guiana wear no garlands, nor do they cultivate a single flower for ornament. It is not only among the more showy genera, such as *Cattleya* and *Odontoglossum*, that individuality is conspicuous, but brassias, gongoras, and even some of the more insignificant families, are equally variable.

It is only in our gardens that we can observe the many variations of large trees, and here we have, unfortunately, but few species from the forest. By studying the vegetation on every trip to the bush, we

see that, although there are differences between wild specimens and those under cultivation, these are generally unimportant. As we stated above, they have their two seasons every year, when they drop their leaves, flower, and later ripen their fruits. Flocks of parrots and other frugivorous birds indicate by their congregating that the fruit season has arrived, while a great increase of fish in the creeks confirms the fact. Haws and other berries of temperate climates often remain on the bushes for months after they are ripe, but most tropical fruits fall quickly. Birds and monkeys would suffer greatly if the season lasted for only a month or two. There appears to be little migration in search of food, although this takes place to some extent. Individuality among the trees is, therefore, of advantage to animals, as it lengthens the season and prevents anything like a dearth for a long period. Birds and monkeys hardly ever alight on the ground, so that once the seed or fruit has fallen it is lost to them and eaten by rodents, or carried away to feed the fish which congregate in every little stream.

Young trees are at first very erratic, opening their flowers and shedding their leaves regardless of the proper season. Some, like the flamboyant (*Poinciana regia*), are never bare, although the older trees lose their leaves entirely and remain so for several weeks. As they become mature their habits are more and more regular until individuality is lessened and they become part of the crowd. In studying the flowering and fruiting seasons, therefore, the naturalist has to generalise from trees of full age, and avoid all deductions from erratic youth. It is almost as difficult to find out their characters as those of young animals at a similar stage.

Among the difficulties of the naturalist are changes produced by removal. He cannot study the epiphytal orchids in the forest, but must bring them to his garden, and thus change their environment. Heredity and individuality will, of course, be the same under all circumstances, but the other great factor in evolution must be interfered with. Few orchids are fertilised when growing on the coast, probably because the insects of the forest are wanting, but these go to prove what a wide field for observation there is among this family alone. Almost hidden among the foliage of a tropical garden, however, some orchids will attract a crowd of insects as soon as their flowers are open. Some of these can hardly be found at other times, but let the flowers open in the early morning, and they call attention to the fact by humming and buzzing around them.

The student of nature in the tropics should be something more than a specialist. Flowers must be studied in connection with insects, and fruits together with birds, bats, and even fishes. The interdependence of animals and plants is so close, that they seem to be engaged in a race where each tries to outstrip the other for his own advantage. The tree invites the perfect insect to fertilise its flowers, but warns off the larva by nauseous secretions in its leaves. Some

caterpillar or other is, however, almost always found to digest the most repellent juices and make all such efforts fruitless. A few have attained a large measure of success on account of the toughness of their leaves and their covering of stiff bristles or thorns; but the most curious provision is, perhaps, that by which a garrison of carnivorous ants is accommodated. Either in swollen petioles or bases of thorns the ants take up their abode and fall upon and destroy every invader.

It is generally found that the trees most commonly attacked by larvæ are those the flowers of which are nectariferous, and therefore provide food for the perfect insect. The fiddle-wood tree (*Citharexylon*) is a striking example of this. Its spikes of white flowers perfume the air at night for long distances, and attract large numbers of moths. These same insects lay their eggs upon the tree, with the result that myriads of larvæ are produced, and the tree is often denuded of every leaf. In the ordinary course of nature it drops its leaves and is bare for a few days, after which the flowers are produced. The result of the ravages of the larvæ, like that of a ruthless pruning, is similar, so that by the time the perfect moth emerges from its pupa-case the flowers are ready to provide nectar for it. Other trees are attacked in the same way, and careful observation will no doubt show that there is something so remarkable in the actions of both plant and insect that nothing short of design can account for it.

Plants are undoubtedly improved by having to contend with so many difficulties. The survivor is always the fittest and most suited to the environment. One contrivance after another is developed, with good, bad, or indifferent results, but generally somewhat to its advantage in over-reaching its neighbours. Meanwhile, however, its rivals have not been sleeping, but as fast as the one gains an advantage others will have put on some defensive armour, or perhaps become more fitted to assume the aggressive. The study of the innumerable contrivances by which the plants of Guiana have attained their present stage is a never-ending source of interest. Probably there is more to be learnt here in a few miles of forest, river, and swamp, than in the whole of Europe, while the difficulties of a thorough investigation of even one square mile are enormous.

In Europe a large number of trees are anemophilous, but here all are fertilised by insect agency. This is one of the reasons why insects are so plentiful. At some seasons great moths fly into our open rooms at night, often to fall a prey to the gas lights. Sometimes a table below the chandelier becomes littered with hundreds of small moths and other insects in an hour or two. If a tree is flowering outside, and happens to be one of those that are fertilised at night, the increase is most striking. The moths fly towards the white flowers and are apparently attracted farther by the intenser light of lamps. In the streets of Georgetown the arc electric lamps also attract great numbers of insects, including some of the largest moths, which may be seen wheeling round them almost like

swarms of bees. By far the greater number of insects are nocturnal in their habits, and, as might be expected, white flowers are very plentiful. This makes observation so very difficult, as few of the insects can be seen at work. Now and again, however, a belated moth may be seen taking a last sip in the early morning, but such cases are rare.

After the contrivances for fertilisation, those by which fruits are protected and disseminated are most interesting. Nearly all those of our tables have thick skins, often charged with acrid secretions. These have acted so well that fruit-eating flies and wasps are almost wanting in Guiana. Birds, however, peel some of them, while bats succeed in utilising all except perhaps those of the orange family. In the forest the variety of pods, capsules, berries, and other seed-vessels is almost overwhelming. Perhaps the most useful developments which are common to almost all are those by means of which they float and are carried long distances by water. This object is generally attained by means of spongy pericarps, but many other devices are common, all helping to spread the seeds over very wide areas. In the Lecythideæ we have apparently protective contrivances against monkeys. The Brazil nut (*Bertholettia*) has a hard, woody capsule without an opening, which falls to the ground entire. In the genus *Lecythis* there is a cover which falls off when the nuts are ripe, and allows them to scatter in every direction. It is probable that monkeys try to get at these, and by loosening the covers let them fall out without being able to secure more than one or two. The cannon-ball tree (*Couroupita*) has a softer covering, but this smells so very disagreeably that neither monkeys nor rodents will touch it. Other natural orders repel animals in different ways. The short brittle hairs on the cowhage (*Mucuna*) pods would undoubtedly prove more than distasteful to bird or beast, as would also the prickles on the seed-vessel of the *Allamanda*. Sometimes the seed itself is protected, while the covering or pulp surrounding it is obviously intended to attract. In such cases birds assist the tree by scattering its seeds, and are therefore invited. In the bignonias, so common along the banks of the rivers, the seed has a delicate membranous expansion, on which it floats in the air like a butterfly. Other climbers have feathery appendages, while the stately *Triplaris* lets its seeds sail down like shuttlecocks.

Fibrous coverings to the stems are common among the tropical weeds. Exposed as these are to vicissitudes unknown in the forest, they have developed contrivances distinct from those of the trees. The most common mode of overcoming the difficulty of a dry season when the roadsides can no longer supply sufficient moisture is the faculty of ripening seeds before this takes place. In the forest, every plant is a perennial, but annuals are common on the dry savannahs, as well as on waste land in the towns and villages. Many weeds are not only repellent to man, but even to domestic animals

and other plants. They are so aggressive in their very nature that they overpower the more delicate plants. All along the coast of British Guiana, where a narrow fringe is under cultivation, hardly a native plant is to be seen, but a host of tropical weeds covers the parapets of the roads and every piece of ground otherwise unoccupied. They even penetrate long distances into the interior where there is a clearing, ousting the more delicate ferns and grasses natural to the locality. These latter may occupy the provision ground of the Indian without interference, but where the white man or negro makes his home the weeds follow him. One of the most common in pastures is the black sage (*Varronia curassavica*), which stands up defiantly, as if it knew that not even a goat or donkey will touch it. But of all these pests the sour grass (*Paspalum conjugatum*) is, perhaps, the worst. It is so rampant in the wet seasons that it allows nothing else to exist where the ground is moist. Disliked by every animal, it covers all the road-sides, and is a perpetual eye-sore to the agriculturist. Other weeds affect dry places, holding their own by pushing thick roots or tubers far below the parched surface. Like the forest trees, weeds struggle with each other, and, according to the season, either come to the front or give place. Where there is not much traffic on the roads, the grasses and other weeds cover them entirely, and even in the city they encroach so far that periodical cleaning is necessary. The dams of plantations are often almost impassable on account of tall grasses, which rise to a height of five or six feet. Many of these have serrated leaves, and the pedestrian, in pushing his way, gets his hands and face disfigured with scratches which in some cases may prove serious cuts.

As in the forest the trees take care not to allow the sunlight to penetrate and raise up a host of rivals, so on the plantation the agriculturist must keep the soil occupied to prevent weeds from spreading. The labour of weeding, when this is not done, is most arduous. In Europe, most of the pests of arable land are annuals which can be easily destroyed by the hoe. Here, however, the tufted grasses and sedges, deep-rooting shrubs, and tangled creepers are exceedingly difficult to eradicate. Only the dense jungle of a cane-field, or the shade of thick-growing trees, can keep them under without man's interference. Not a single weed shows itself among the sugar-canes after they have got beyond their earlier stage, and when ripe no large beast, much less man, can penetrate them. Here, instead of individuality, we have something like combination for an object, examples of which are more common in temperate climates than in the tropics.

JAMES RODWAY.

V.

The Distribution and Generic Evolution of Some Recent Brachiopoda.

WE had recently occasion to summarise the salient features of some modern publications on the anatomy and development of the Brachiopoda.[1] The past year was certainly remarkable for the production of excellent memoirs on this group of organisms. The great work, modestly entitled by Professor James Hall "An introduction to the study of the Genera of Palæozoic Brachiopoda," noticed in the October number of NATURAL SCIENCE (p. 628) is truly of an epoch-marking character, and a distinct revelation that the problem of the origin of species, so far as the Brachiopoda are concerned, is becoming merged in that of the evolution of genera.

It may be as well to recall the fact that the results of three American dredging expeditions and several French marine explorations have been worked out since Davidson's Report on the "Challenger" Brachiopoda was issued in 1880. It is from a review of the material obtained by the "Travailleur," the "Talisman" (2, 3), the scientific mission to Cape Horn of the "Romanche" (4), and three of Prince Albert 1st of Monaco's "Hirondelle" voyages (5) that the well-known French conchologists, Dr. Paul Fischer and D.-P. Œhlert have jointly derived the conclusions to which we are about to refer. It is fortunate that the rich harvests of results gathered in such distant regions should have been all entrusted to the experienced hands of the authors of the "Manuel de Conchyliologie et de Palæontologie conchyliologique." They have thus been enabled to formulate generalisations of value concerning the transition of genera, the distribution of some recent species, and their relations to the fossil forms of the Tertiary epoch. It is, perhaps, advisable to premise that Bayle's name *Magellania* is employed throughout to replace that of the far more familiar generic appellation *Waldheimia* of King, the use of which has been abandoned by Messrs. Œhlert, Fischer, Dall and others, because it had been previously given a few years before to a genus of hymenoptera; although, as M. Eugène Deslongschamps has observed, it would seem impossible that anyone could confuse a

[1] NATURAL SCIENCE, vol. i., p. 603.

Brachiopod with that most ill-met insect. We adopt the new name for the sake of uniformity, and in order to avoid the undesirable repetition of the bracketed tri-nomen which is making too frequent appearances in modern scientific literature. The substitute possesses the unusual merits of commemorating the exploits of a celebrated navigator, and of indicating at the same time the region of the maximum development of the genus it distinguishes; for the Magellanian province, as Darwin first pointed out, is remarkable for the great size of the mollusca inhabiting it, and to this rule the Brachiopoda form no exception.

First in interest and importance is the report of Messrs. Fischer and Œhlert on the Brachiopoda of the North Atlantic Ocean, which forms the third fasciculus of the fine series of Monographs embodying the results of the scientific explorations of Prince Albert 1st of Monaco on board his famous yacht "L'Hirondelle" (5). It gives a critical revision of the recent *Terebratulinæ*, accompanied by exquisite illustrations, and reveals some surprising facts in the general distribution of North Atlantic Brachiopoda, more especially in the Gulf of Gascogny, the archipelago of the Azores, and off the shores of the Soudan (5). The Gulf of Gascogny appears to be one of the richest localities, no less than sixteen species occurring there, including abyssal forms.[2] By far the most remarkable among them is the beautiful species founded on a single example first dredged by the "Challenger" Expedition from 390 fathoms off Culebra, one of the West Indian islands, and originally described by Davidson as the largest *Terebratulina* known (1).

This is undoubtedly a very interesting type. Fischer and Œhlert had several examples for examination, and were able to study the animal in detail, which was described by Willemöes-Suhm, in his MSS. notes, as relatively very small. It is now considered to be the type of a new genus, and of a new family (3), "characterised by its non-annulated loop and the arrangement of the arms, which, instead of forming free lobes, are re-united, and, rolled up in the pallial cavity, present a short sub-rectangular disc, a unique feature among the recent Brachiopoda. This disc can be schematically considered as composed of two rudimentary arms, joined laterally, and furnished with a large brachial sinus" (5). The figures now given show great incurvation of the beak area, and thickened margins of the valves—features which are also apparent in Davidson's drawings of the species. Hence we are inclined to consider *Dyscolia wyvillii* to be one of those atavistic types which Dr. Beecher states occur generally in families after the maximum of genera and species is attained.

This is a widely-distributed species, ranging from the West

[2] Twice that number of species are recorded, from Japanese and Corean waters, by Davidson in his "Monograph of the Recent Brachiopoda," *Trans. Linn. Soc. Zool.*, vol. iv. (1886–1888), p. 33.

Indies to the Gulf of Gascogny. It occurs off the East African coast, on the shores of the Soudan, and also in the latitudes of the Azores, another prolific region, yielding twelve species of Brachiopoda, of which four are also common to the West Indies, and eleven to European seas. A species dredged off the Portuguese coast, and named *Terebratula sub-quadrata* by Gwyn Jeffreys, is now regarded by Fischer and Œhlert as very closely allied to *Dyscolia wyvillii*, and the same authorities recognise *Terebratula* (*D.*) *guiscardiana* from the Sicilian Pliocene as an ancestral form of this interesting family Dyscoliidæ. The authors concur with Davidson in regarding the *T. septentrionalis couthouy*, which is larger and more rounded than the elongated and sub-pentagonal *T. caput-serpentis*, as a distinct species. They note, however, the occurrence of the varietal form they have named *T. germana*, from the Cape de Verde islands, and suspect it to be allied to the examples of so-called *T. septentrionalis*, recorded from the South Atlantic (Cape of Good Hope), the Indian Ocean, and Prince Edward's Island (5).

Sixteen deep-water species were obtained during the "Talisman" and "Travailleur" expeditions, three of which, *Rhynchonella cornea*, *Eucalathis tuberata*, and *E. ergastica*, were previously little known (2). Thirteen of them, according to Messrs. Fischer and Œhlert, occur in a fossil condition in the Pliocene marine deposits of Sicily and Calabria. These species are either absolutely identical, or at least exhibit such slender differences as permit their describers, in calling them by different names, to indicate a common origin. The Zanclean Sands of South Italy yield an assemblage of fossil forms which recalls the abyssal fauna of the marine Lusitanian province. We learn (2) that three species, *R. sicula*, *Dyscolia guiscardiana*, and *Muhlfeldtia (Megerlia) granulata*, have become extinct in the Mediterranean, while such closely allied forms as *R. cornea*, *D. wyvillii*, and *M. echinata* continue to be perpetuated in the Atlantic Ocean. Three other species found in the Pliocene of South Italy, *Magellania peloritana*, *M. euthyra*, and that widespread and interesting species *Liothyris sphenoidea*, which was long known as a fossil before it was dredged in the living state, appear to be absolutely on the point of extinction in the Mediterranean (2), although they are still represented in the broad Atlantic under the designations of *Magellania septigera*, *M. cranium*, and *Terebratula cubensis*.

Hence it is evident, the French conchologists conclude, that the Mediterranean has lost some of its deep-water species since the Pliocene period. This tendency is still manifested, and it is held to be associated with the gradual rise in the temperature of the Mediterranean waters which is about + 13° C., from below 183 metres down to the bottom. The Mediterranean now resembles an inland sea as compared with the Atlantic, where the temperature decreases as depth increases. The fact of the general uniformity of deep-water temperature, first established by the "Challenger" explorations,

accounts for the wide distribution of the abyssal fauna. During the Pliocene period, the cold currents penetrated into the Mediterranean, which then received a number of hardy boreal species, the remains of which have been preserved in the fossiliferous deposits of Ficcarazzi, in Sicily. The elevation of the sea-bottom at the Straits of Gibraltar checked the inflow of the cooler currents of the ocean depths, with the consequent result of a gradual rise of temperature in the then nearly enclosed sea. The abyssal forms, being unable to accommodate themselves to the changed conditions, died out in the thermal waters, but their collaterals continued to flourish and multiply in the favourable and unchanged conditions of the Atlantic Ocean (2).

These considerations, Dr. Fischer and D.-P. Œhlert maintain, confirm the hypothesis that the distribution of marine species is principally regulated by the temperature of the waters. Hence it arises that the Mediterranean Sea now possesses a rich surface fauna and a poor abyssal one; while the Lusitanian province beyond is characterised by a poor surface fauna and a deep-water fauna of extraordinary richness and vitality.

The results derived from a careful study of the specimens obtained by the "Romanche" during the French scientific mission to Cape Horn (4) were of a different character, and, while affording some distributional data of interest, which serve to emphasise the great dissimilarity existing between the boreal and the austral brachiopodal fauna, yielded more important evidence concerning the transitional stages of development of the larger southern species of *Terebratella* and *Magellania*. These successive stages are shown to be of a more complicated character and to differ somewhat from those undergone by the northern forms as first described by Herman Friele, who based thereon his simple division of the great family of Terebratulidæ into two groups of the short loops and the long loops since generally adopted. It is now quite clear that the genus so long known as *Waldheimia* is a closed type, the ultimate phase of a long line of development through successive pre-magadiform, magadiform, magaselliform, and terebratelliform stages culminating in the southern seas in *Magellania venosa*, *M. lenticularis*, and *M. grayii*. It is remarkable that the species of the Northern Ocean should reach the same goal by a shorter line and somewhat different stages, which Œhlert and Fischer define as centronelliform, ismeniform and terebratelliform, ultimately attaining the Magellanian grade as represented by *Wald. septigera* and *Macandrewia cranum* (4).

Davidson's classification of the long-looped species of *Waldheimia* with the short-looped species of *Terebratula*, *Liothyris* and *Terebratulina*, which assume their stable generic loop characters without undergoing any metamorphoses, cannot possibly be longer sustained. It is quite evident that *Magellania* has absolutely no affinities with the sub-family Terebratulinæ, but must be associated with the Terebratellinæ and should rank above that genus in a natural scheme of classification, as

Dall suggested in 1891.[3] The following subdivisions of the great family Terebratulidæ, which we should place in the following order, were proposed by Œhlert in 1887:—Terebratulinæ, Centronellinæ, Magasinæ, Muhlfeldtinæ, Terebratellinæ and Magellanæ. The present investigations confirm this grouping. The genus *Terebratula* of the first-named and *Centronella* of the second are the more ancient terebratuloid types, and were represented in the Silurian seas.

Messrs. Œhlert and Fischer received the materials for their research on the Brachiopoda of the Magellanian province too late to permit of the publication of their conclusions in the series of memoirs relating to the French scientific mission to Cape Horn, during which the "Romanche" dredged often in many localities. Few species were obtained, but the number of individual specimens of different ages was large, and afforded them much desired opportunities for studying the metamorphoses of the loop and gradational development of *Terebratella dorsata* and *Magellania venosa*. The knowledge thus gained, it is distinctly stated, should tend to the suppression of many so-termed species and some assumed generic forms, for "the more the Brachiopoda are studied the more the number of legitimate species will decrease." It is demonstrated that the same individual in the course of its post-embryonic development assumes successive stages which are identical with both specific and generic forms of various authors. Thus it is fully proven that the genera *Waltonia* (Davidson) and *Magasella* (Dall) are really immature *Terebratellæ* in which the brachial apparatus has not completed its development. Gould's *Terebratella pulvinata* is shown to be merely a stage of *Magellania venosa*, which is not permanently arrested in the terebratelliform grade like its congener *Terebratella dorsata*, but assumes ultimately the characteristics of *Magellania venosa*. This is a fine but variable species with a large number of synonyms which have been well worked out by Davidson. Messrs. Œhlert and Fischer state that it attains maturity early, and its complete evolution was observed by them in specimens 27 mm. long in which all traces of the jugal band had disappeared. The largest known specimen measures 3 inches 2 lines in length and 2 inches 8 lines in breadth. *Magasella gouldi* becomes *Terebratella gouldi*, but it is not yet known whether it stops there or eventually assumes the generic characters of some species of *Magellania*. It is certain, however, that *Magasella evansi* is but a phase of *Terebratella cruenta*. *Magasella patagonica*, *M. flexuosa*, and *M. suffusa* name different ages of *Terebratella dorsata*, *M. lævis* another stage of *Magellania venosa*, while *M. adamsi* first becomes terebratelliform and eventually passes into *Magellania grayii* (4).

In the course of these investigations the important physiological facts of accelerated growth were recognised. Owing to favourable conditions of the environment, some adolescent individuals were

[3] The name *Terebratulinæ* was accidentally printed for *Terebratellinæ* on line 19, p. 603, of my paper "Recent Researches on the Brachiopoda," in NATURAL SCIENCE, October, 1892. The error escaped notice.

found to be obviously capable of reproduction during the Magasiform and the Magaselliform phases, which precede that of *Terebratella*, and thus an inferior race of *Magasellæ* is perpetuated which never attains the characteristics of the adult *Terebratellæ*. The authors deem it advisable, therefore, to retain Dall's subgeneric name of *Magasella* for such permanently arrested types, although it is quite clear that four-fifths of the so-called species will prove, as the American authority admits, to be the immature forms of different species of *Terebratellæ*, with which genus, it is well to remember, they invariably occur associated. Some *Terebratellæ* also remain so throughout life, but with others the terebratelliform stage is transitory, and they pass up into true Magellanæ. Many such grades were arrested and became stable during geological periods, and should therefore retain generic value. Among these the authors cite *Centronella*, *Magas*, *Terebratella*, and possibly *Ismenia* of King.

This is a distinct advance in our knowledge of the Brachiopoda, and throws some light on the origin of genera. It illustrates at the same time the difficulties under which palæontologists labour in describing and naming obscure fossil forms, deprived of the assistance to be derived from a study of the developmental history of any member of the group in the living condition. The simultaneous occurrence, so often noticed, of a smooth series and of ribbed examples of the same species, indicate the futility of relying on these mutable external features as indicators of species. The most divergent views are taken of generic values; for instance, Mr. H. Douvillé proposed his genus *Neothyris* for *Waldheimia lenticularis*, a well-known form occurring in the New Zealand province, both in the living and fossil condition, allied to the *W. kerguelenensis*, and so closely related to the giant *W. venosa* of the Magellanian province, that Dall even considers it as a varietal form or Novo-Zealandian race of the S. American species. "The difference in colour seems the main distinction" (4). Œhlert's sectional employment of the term Neothyrine as differentiating the smooth *Magellanæ* like *venosa*, and *lenticularis*, from the pleated forms, such as *M. flavescens*, is far less objectionable.

Now that *Terebratulina wyvillii* has been definitely promoted, and with good reason, to be the type of a new family, the Dyscoliidæ, in which the short united "arms" resemble a freemason's apron, the fine *T. crossii* from Japanese waters is the largest known species of that sub-genus. It is remarkable that it should have been also dredged by the "Romanche" off the coast of Patagonia. *Liothyris moseleyi*, first obtained by the "Challenger" off Kerguelen islands, and subsequently by Dall in the West Indies (Blake Expedition), also occurs off Tierra del Fuego, and proves to be a well-defined, far-ranging species of the widely-distributed Liothyrine group of *Terebratula*.

The Magellanian province, to which the Marion isles, the Crozets and Prince Edward's Island are now attached by Œhlert and

Fischer, is poor in species but rich in individuals. Favoured by abundant marine vegetation, the species so numerously represented attain relatively gigantic dimensions. Seven species occur, one of which, *Magellania fontaineana*, Davidson held to be only a synonym of *M. venosa*. The French conchologists consider it distinct, and as still inhabiting the littoral. It is found fossil in Chili, and *Terebratella cruenta* occurs in far distant New Zealand. A close similarity, it is evident, exists between the brachiopodal fauna of the Magellanian province, where the species are practically colourless, and the bright-hued forms of the Novo-Zealandian. The rich colouring is regarded as an adaptation to the brilliant marine vegetation. The Kerguelen islands occupy an intermediate position, both as regards geographical situation and specific distribution, although the temperature of the bottom currents is identical with that of Tierra del Fuego. The fauna of the Magellanian province differs radically, alike from the Boreal and from that of the Tasmanian region, which is linked by its characteristic Kraussinoid types with the Cape of Good Hope, and connected with the Kerguelen islands by the occurrence of the same genus, a species of which abounds in the latitudes of St. Paul's islands. Fishes seem to be ardent collectors of Brachiopoda. Two specimens of *Magellania venosa* were found in the stomach of a cod in New Year's Sound. *Terebratulina septentrionalis* occurs frequently in the same situation off the banks of Newfoundland, and a much rarer species of the genus was originally described from a single specimen taken under similar conditions from a fish captured at a depth of 80 fathoms off the Mauritius.

A detailed comparison of the Austral species leads Messrs. Œhlert and Fischer to confirm the hypothesis "of the existence of an extended but hitherto little-known Arctic and circumpolar fauna." In a short paper, just issued, the authors summarise the results of their observations "On the evolution of the brachial apparatus of certain Brachiopoda" (6), and present a tabular view of the affiliation of the *Magellanæ*. They suggest the subdivision of the genus into two sections, differentiated by distinct lines of development and by the characters of the adult species. By their original and well-executed researches they have added considerably to our knowledge of the distribution and generic evolution of the recent Brachiopoda.

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AGNES CRANE.

V.

Aggressive Mimicry Among the Flies of the Genus *Volucella*.

MUCH attention has recently been drawn to the resemblances which exist between the forms of *Volucella* and certain species of Hymenoptera. Not only are theoretical explanations of the resemblances in dispute, but there is disagreement as to the exact species of *Bombus* which are mimicked. It may therefore be opportune to describe briefly the characters both of the Diptera and Hymenoptera concerned.

In England, there occur four species of the genus *Volucella*; of these, *V. inanis*, *V. pellucens*, and *V. inflata* possess a smooth or nearly smooth body, while *V. bombylans* alone possesses a markedly hairy body.

V. inanis is parasitic in the larval condition on the larvæ of wasps and hornets; the adult in no small degree resembles a wasp. *V. pellucens* and *V. inflata* are similarly parasitic on wasps, but neither can be considered to bear a resemblance to its hosts in the adult stages. The larva of *V. bombylans* is, in the same way, parasitic on certain species of the genus *Bombus*. The adult of this last occurs in two varieties; the dimorphism affects both sexes, and intermediate forms are occasionally found.

The one variety is black, with the apical portion of the abdomen red. It thus closely resembles, both in size and colour, a small worker of *Bombus lapidarius*, or of *B. derhamellus*, or of *B. sylvarum* (in some of its variations). The other, var. *mystacea*, has a yellow border to the otherwise black thorax, yellow hairs on the basal portion of the abdomen, which is itself in this region yellow and semi-transparent, and a grey or greyish-yellow apex to the abdomen. The exact extent of the yellow colouration is liable to variation both on the thorax and abdomen. Here the resemblance is to a worker of such species of *Bombus* as *B. pratorum*, *B. hortorum*, *B. schrimshiranus*, *B. terrestris* (*lucorum*), or *B. sylvarum* (in other variations). The two varieties present also a superficial resemblance, when on the wing, to two other bees, viz., *Anthophora retusa* and *A. pilipes*. The males of these two bees are clothed with brownish hairs, which fade to a yellowish grey in weather-beaten specimens, with a considerable mixture of black in certain lights; the females are entirely black

But it is rather in size, and especially in mode of flight, that *V. bombylans* resembles the *Anthophoræ*. In both cases the insects have a dashing impetuous habit, interrupted by periods of hovering. During such rapid movements exact markings fail to catch the eye, and the general impression produced by the two is by no means dissimilar.

It is further maintained by some observers that var. *mystacea* resembles *B. muscorum*. This bee has tawny yellow hairs on the thorax, while on the abdomen the hairs are yellow, more or less mixed with black, or even entirely black. Whether mimicry can be said to exist in this case is a matter of opinion, but it should be borne in mind that both *B. muscorum* and the *mystacea* variety of *V. bombylans* vary in appearance and colour-effect, according to the direction from which they are observed. A freshly-emerged *mystacea*, if viewed from in front, and from a low elevation, would probably be considered by very many persons to resemble *B. muscorum*, while, if viewed either from directly above or from behind, the resemblance would probably be denied. Moreover, a faded specimen of *muscorum* loses much of the tawny colouring and appears of a yellowish grey.

Both varieties of *V. bombylans* have been observed to emerge from nests of the three species of *Bombus* which are chiefly attacked, viz., *B. muscorum*, *B. lapidarius*, and *B. hortorum*. The first-named of these is apparently the most infested. In this connection the habits and demeanour of the bees are of interest. *B. muscorum* constructs a nest on or near the surface of the ground, and is of a comparatively mild and pacific disposition. The other two construct their nests at some depth from the surface, and are, especially *lapidarius*, fiercely irritable. Thus the nest of *muscorum* is clearly more accessible to *Volucella* on account both of the weakness of its strategic position and the faint heart of the defenders.

Be this as it may, it is exceedingly difficult to comprehend how the colour of *Volucella* can in any way impose upon any of the bees, for so soon as the fly has entered the approach to the nest it must be in more or less total darkness, and from that moment the value of mere colour and markings is reduced to *nil*. Any *Bombus* which encountered a *Volucella* in the darkness could not by any possibility discriminate by the sense of sight between friend or foe. It seems far more probable that the hairiness of *V. bombylans* (in both varieties) is the feature which should be spoken of as an example of "aggressive mimicry." It is the sense of touch which alone can enable the *Bombus* to detect *V. bombylans* in the semi-darkness, and surely the hairy body is less likely to arouse suspicion when touched than would a smooth body, for the latter could in no case enter the nest of *Bombus* as belonging to one of the natural members of the colony.

This contention derives much support from the fact that the other three species of *Volucella* mentioned above have hairless bodies and are parasitic upon hairless Hymenoptera. Our knowledge at

present is insufficient for us to be able to determine whether the hairiness of *V. bombylans* is as the "skins of the kids of the goats," or if the Esaus of the genus have practised the converse deception.

If this theory be correct, the colouration of *Volucella* must be removed from the category of "aggressive mimicry"; unless, indeed, the general bee-like appearance disarms suspicion when the *Volucellæ* are flying in the neighbourhood of the nests of the *Bombi*. It seems more probable that the dimorphic mimicry of *V. bombylans* is of "warning" value, and this is far more in accordance with the mimicry occurring in dimorphic forms among other groups of insects. During the past summer I made a few experiments to test this point. Specimens of *V. inanis* and of both varieties of *V. bombylans* were offered to six lizards whose ordinary diet consisted of worms, blue-bottle flies, and caterpillars. In each instance the *Volucellæ* were inspected from a distance and watched attentively, but not one was tasted or even licked. When the *Volucellæ* flew round the cages the lizards exhibited the utmost alarm.

These lizards were brought from Italy in the spring, and had not previously, while in my keeping, been alarmed by any bees or other insects capable of inflicting injury upon them. It was interesting to observe that the wasp-like *V. inanis* was evidently regarded with greater fear than *V. bombylans*. The same dread of any insect banded with black and yellow, *e.g.*, larva of *Euchelia jacobeæ*, was frequently exhibited.

It is evident that as yet we are not in a position to dogmatise concerning the mimicry exhibited by these (and many other) insects. Now that attention has been called to our previous somewhat hasty conclusions, it is to be hoped that the work will be taken in hand by many independent observers during next season. The *Volucellæ* abound in nearly all country places, and are easy to keep under observation in captivity. An interesting point to record, among others, would be the relative proportions of the sexes in the two varieties of *V. bombylans* and the *mystacea* variety. In a series of fourteen taken last summer, consisting of eight *V. bombylans* and six var. *mystacea*, all the former are males, but only one of the latter. Theories to explain mimicry we have in abundance; let us hope for more facts in the future.

OSWALD H. LATTER.

VI.

The Rothschild Museum, Tring.

SO considerable a part of the richness of our public collections in Natural History is due to the interest and munificence of private individuals, that every true student will welcome with gratitude each new recruit in the ranks of those who devote their energies and resources to the amassing of materials for investigation. Of these disinterested workers, who not merely collect but also pursue scientific research, there are happily many still rising in Britain to replace the older generation now quickly passing away: and conspicuous among those in the forefront of progress must be placed the Hon. L. Walter Rothschild, whose interest in the cause of Natural History has of late attracted so much attention. Since his undergraduate days at Cambridge, when he came under the influence of Professor Alfred Newton, Mr. Rothschild has devoted himself with enthusiasm to the pursuit of Ornithology and Entomology; and while following these studies he has not remained satisfied with the resources of the University and National Museums, but has amassed great collections which in some respects rival, and even surpass, those of the British Museum itself. His endeavours have met with so much success, that he has recently erected a commodious museum at the town of Tring, his place of residence, to contain the collections; and he has now added to his private cabinets of Ornithology and Entomology a fine series of typical animals of other groups, arranged for the instruction of the general public, who are admitted on four days of the week. Few naturalists have hitherto visited the museum, the study-cabinets being still incomplete; but, by the courtesy of Mr. Rothschild, we have lately enjoyed the privilege of seeing the arrangements so far as advanced, and it will be of interest to those engaged in research to learn the present position and prospects of the institution.

The Museum and "Cottage," of which we give a side-view in Fig. 1, is a red brick structure, about 100 ft. long by 50 ft. broad. Attached to one of the outer walls is a taxidermist's and general workshop; while, a short distance away, a space of ground, occupied by cages and a paddock, is arranged for the accommodation of living animals, kept for the observation of their habits and life-history. The museum itself consists of one large room, 65 ft. by 32 ft., with a gallery all round, some 15 ft. from the floor. Two large glass cases, about 50 ft. long, occupy the central floor, and the whole of the wall-space, both on the ground floor and in the gallery, is one continuous

glass case of moderate depth. There is, therefore, scarcely a square inch of waste room anywhere. The cases themselves are beautifully fitted with mahogany, somewhat similar to those at the Natural History Branch of the British Museum, though considerably improved. The tops of the central cases are solidly constructed, and by this neat device form, as it were, a central floor to the gallery above, occupied by large specimens too bulky for the glass cases themselves. Additional specimens, chiefly large fishes, are suspended from the roof at a level with the eye of the visitor in the gallery, as shown in Fig. 2.

Entering the museum on the ground floor, one finds the whole of the right-hand portion devoted to birds, and the whole of the left-

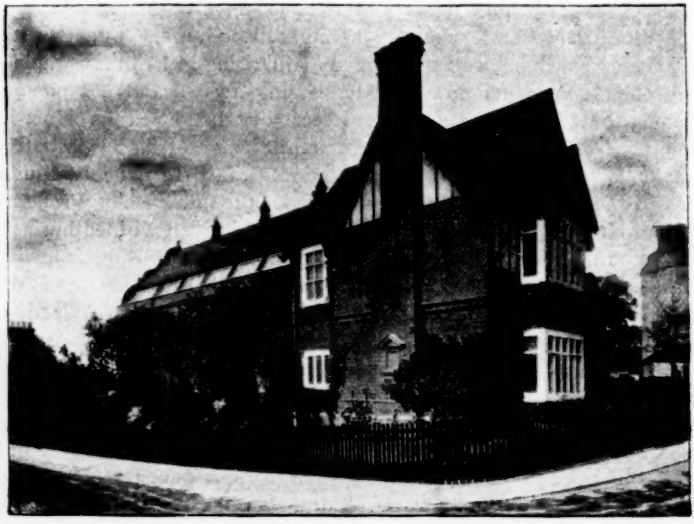


FIG. 1.—THE ROTHSCHILD MUSEUM, TRING.

hand half to mammals; while upstairs in the gallery the typical series of sponges, corals, molluscs, fishes, and reptiles are in the wall case, and the insects, with crustaceans, occupy small boxes with loose wooden doors (to exclude light), fixed to the hand-rail of the gallery balustrade, as shown in the foreground of our illustration. On the side galleries these boxes are hinged to permit of their being lowered to hang parallel with the balustrade; such an arrangement not only allowing an uninterrupted view of the specimens placed on the top of the central cases, but permitting the top-light to fall freely on the ground floor.

The whole of the exhibits in the Museum cases, with some exceptions among the mammals and birds, form what Mr. Rothschild

terms his "Public Collection"; and this is regularly open to the inspection of visitors. The private cabinets for study are arranged in the "cottage" at the entrance, and in the "bird rooms" at the opposite end of the museum. The Bird Room on the ground floor is already fitted with cabinets and provisionally arranged. The collection comprises about 30,000 skins of from 5,000 to 6,000 species, and is especially rich in "types." The specimens are preserved, the larger ones in glass-topped drawers, and the smaller ones in light glass-topped drawer-trays, the birds lying in rows in cardboard grooves. This arrangement is found peculiarly convenient, permitting, as it does, the whole of the individuals of a species to be

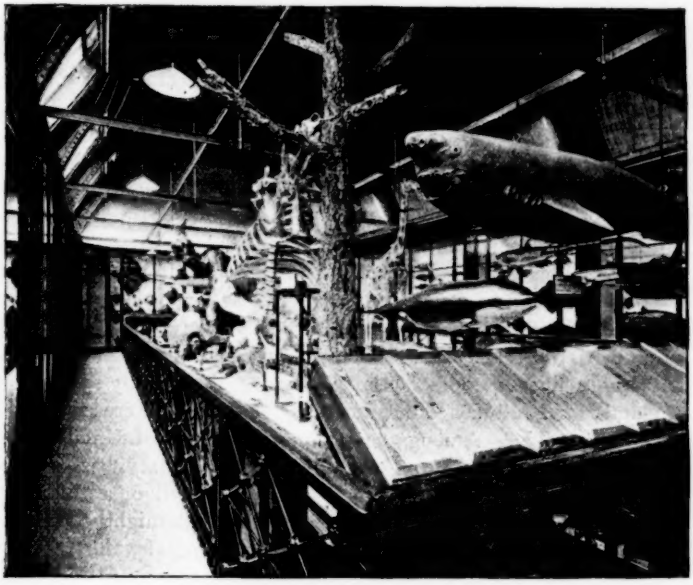


FIG. 2.—THE UPPER PUBLIC GALLERY OF THE ROTHSCHILD MUSEUM, TRING.

lifted out at once and removed in their own tray to the student's work-room and library. The upper bird room is as yet merely a store-room, and above this is another small store-room in the roof, reached by a spiral staircase.

The "cottage" is separated from the Museum by a wide stone staircase, which forms the public means of access to the gallery. It contains Mr. Rothschild's own study, the curators' room, the library, and the entomological cabinets. The library is certainly the most useful and extensive collection of Natural History serials we have seen in a private institution; the special works on Ornithology and Entomology are mostly represented, and are being constantly added

to. The Coleoptera are arranged in glass-topped boxes in bookshelves on the staircase and in the upper room, while the Lepidoptera are in course of arrangement in cabinets, both in the upper and lower rooms, the collection containing altogether about 200,000 Lepidoptera and 300,000 Coleoptera, and especially noteworthy for the large and complete series of most species. All the specimens placed in the public collection are, of course, duplicates.

Passing to a more detailed examination of the public museum, the first striking feature is the wonderfully life-like aspect of the stuffed birds and mammals. This is due to the fact that Mr. Rothschild employs a specialist in each group, and for each kind of work. For instance, all birds of the duck family, ostriches, &c., are stuffed by Doggett, of Cambridge; the eagles in Switzerland; and the same care and discretion are exercised in reference to the mammals. The fishes, also, in the gallery are, many of them, remarkably good, the work for the most part of the museum attendant. Chief among the mammals may be noticed the large (probably the largest known) gibbon, *Hylobates syndactylus*, brought by Dr. Hartert from Sumatra; while close by, on a small board, there sits in most life-like posture the late chimpanzee, "Sally," from the London Zoological Gardens. The lower monkeys are also numerously represented. Among the Carnivora, a particularly interesting specimen is a hybrid between the lion and tiger; and there is a bear's head from Central Siberia of unusual size, the skull being larger than that even of the largest Cave Bear in the Paris Museum, and said by Milne Edwards to be almost identical in characters with the latter. There is a fine example of the Caspian seal, the only specimen in England; and albinos are numerous, the most interesting being one of the sable. Among the unique specimens of Ungulata, we may refer to a fine quagga—an animal so rare that it is unrepresented even in the British Museum—and the head of a rhinoceros from Central Somali-land, with an enormous straight horn, and possibly of a new species. Among smaller mammals, the recently-described opossum-mouse from New Guinea (*Acrobates*) is conspicuous; and there is also an example of the rare squirrel, *Rhinosciurus tupaioides*, from Borneo. The collection of marsupials is very extensive, comprising a fine series of kangaroos, wallabies, and koalas, &c.; while the monotremes comprise the unique *Echidna nigroaculeata*, lately described by Mr. Rothschild, from New Guinea—a very large animal that lived for some time in Mr. Rothschild's possession, and of which he has carefully preserved the skeleton and the soft parts in spirit.

Among birds, the most remarkable series are those of hybrid pheasants, chiefly bred at Tring Park; of the Tetraonidæ (capercailzies, &c.) from Russia, comprising about 280 specimens; and of the ostriches and other struthious birds. The latter include a fine series of cassowaries, stuffed by Mr. F. Doggett, of Cambridge,

and coloured from life by Mr. Frohawke: the preservation and colouring of the carunculated skin of the neck form one of the greatest triumphs in the taxidermist's art. Young emus, showing the striped character of the early plumage, are also interesting; and to illustrate the development of the struthious birds in the past, Mr. Rothschild has added a model of the skeleton of the New Zealand moa, other moa bones, and a complete egg of the great extinct Madagascar bird, *Æpyornis*. In an adjoining case the display of eagles also deserves special notice.

Passing to the gallery, there are a few striking fossils occupying the walls of the staircase, notably *Ichthyosaurus* and *Steneosaurus* from the Lias, and a large palm-leaf from the Eocene of Monte Bolca, near Verona. A striking object here also is an enormous stuffed python, from Western Africa. The large specimens to be seen from the gallery scarcely require detailed enumeration, the general arrangement being shown in the accompanying Fig. 2. Mr. Rothschild, like a true naturalist, does not regard extinct animals as belonging to a totally distinct domain from those now living; and he thus places, for comparison with the sloths and armadillos, models of the skeletons of *Megatherium* and *Glyptodon*. There is also a noteworthy extinct giant tortoise, *Testudo grandidieri*, from Madagascar, represented only by the shell; the limbs of this animal (it is said) having, by accident, been offered to and purchased by the British Museum. Around the walls are the fishes and reptiles, only a small space being reserved for the other groups, which, as we mentioned above, are confined merely to typical examples. Of the fishes, the best things to be seen are a saw-fish, some sturgeons, some excellent specimens of European species, and a few in spirits. In the hanging boxes on the balustrade the insects are remarkable for their perfection, and here the same rule is carried out, that of showing only typical examples of the various orders.

All these collections are open to the public during certain hours on Mondays, Tuesdays, Wednesdays, and Fridays, and it is gratifying to find that Mr. Rothschild's liberality is appreciated. Since the formal opening early in September, no less than 16,000 visitors have been admitted, and the largest attendance is on the Wednesday evening from 4 to 7, when as many as 300 persons frequently pass the door. The Museum is lighted throughout by electricity, and the rows of small incandescent lamps are most conveniently and admirably arranged.

Referring next to the purely scientific collections, it must suffice merely to enumerate the various series of specimens they comprise. Among birds may be mentioned the following:—

(i.) The Bartlett Collection of weaver birds and finches.

(ii.) The Holdsworth Collection from Ceylon.

(iii.) The Bruijn and Beccari Collection both of birds and mammals from New Guinea, containing many type-specimens of birds described by Count Salvadori.

(iv.) The Whitehead Collection from Palawan and Borneo, with numerous types.

(v.) The Von Hügel Collection from New Zealand.

(vi.) Sir Walter Buller's Collection from New Zealand, containing the types described in the second edition of his classic work.

(vii.) The Palmer and Scott Wilson Collection from the Sandwich Islands and Chatham Island.

(viii.) An extensive collection made by Dr. Ernst Hartert in the Dutch West Indies.

Among insects may be mentioned :—

(i.) The Felder Collection of Lepidoptera and Coleoptera.

(ii.) The Boucard Collection of Coleoptera.

(iii.) Part of the Doherty Collection of Lepidoptera from the Malay Archipelago.

(iv.) The Rev. W. Hamilton's Collection (in part) of Lepidoptera from the Khasia Hills.

Mr. Rothschild, it may be added, is now employing special collectors in the Sandwich Islands and Madagascar, and his series of birds from the first-mentioned islands is already unique.

Enough has now been said to show how vast are the collections already acquired for the Tring Museum, and it only remains to observe how thoroughly Mr. Rothschild is carrying out the undertaking he has begun. Up to the present most of the material has been stored and comparatively inaccessible; but by the appointment of Dr. Ernst Hartert, the well-known ornithologist, as curator, the initial step towards order and arrangement has been taken. The cabinets of bird-skins have already been provisionally arranged; and early next April Dr. Jordan, of Hildesheim, will enter upon his duties as assistant-curator in charge of the entomological collections. The general attendant, caretaker, and taxidermist will also shortly be provided with two additional men. In short, there will be an adequate staff to preserve and render accessible every part of the collections.

It is the custom of certain official naturalists to speak disparagingly of those who, from personal taste, begin to form private collections, afterwards to find themselves deeply engrossed in the subject, and competent to speak with authority on special groups of animals. They declare that private collections are useless, being inaccessible and neglected. We have no sympathy with such expressions in any case; but more especially would we protest against the injustice of those who, even in public meetings, give utterance to these sentiments in reference to the Tring Museum. All the collections are preserved with the greatest care and arranged in the most approved and convenient fashion. As soon as Dr. Hartert and Dr. Jordan have had a brief time for work, everything will be as readily accessible as in the British Museum; and we are permitted to add that, when this arrangement is accomplished,

Mr. Rothschild's collection will not merely be for his own private use and that of his curators, but will be at the disposal of every competent specialist who desires to make use of it for reference. While arranging the collection, Mr. Rothschild and his curators will prepare a catalogue and describe the forms that appear to be new; and the systematic manner in which the collecting is being undertaken in little-explored regions abroad is certain eventually to yield most important results.

In conclusion, we would advise all our readers who are interested in mammals and birds, in the art of taxidermy, or in the arrangement of exhibition cases, to visit the Tring Museum. It is a remarkable and beautiful collection, of interest alike to the wandering amateur and the professed naturalist.

A. Smith Woodward.
C. Davies Sherborn.

SOME NEW BOOKS.

THE VISIBLE UNIVERSE: Chapters on the Origin and Construction of the Heavens. By J. Ellard Gore, F.R.A.S. Demy 8vo. Pp. 346, with 6 stellar photographs and 12 lithographic plates. London: Crosby Lockwood & Son, 1892 Price 16s.

MR. GORE is well known as an enthusiastic observer, an able computer, an authority on variable stars, and the author of successful works which appeal to the general reader and the amateur astronomer. The present volume, like its predecessors, is well written, well printed, and well illustrated. Its main object is to give an account of various hypotheses as to the origin and construction of the heavens, and of the arguments for and against them. In discussing various astronomical fictions, as these hypotheses may be termed, many facts are necessarily described and much interesting information is communicated. Thus, in reviewing the "Meteoritic Hypothesis," the author gives an account of the leading characteristics of stellar spectra and of the recent work by Professor Lockyer, Dr. Huggins, and others, on such subjects as the coincidence of the chief nebular line with the brightest termination of the magnesium fluting.

Mr. Gore has paid special attention to the distribution of stars in space, and this subject is accordingly treated at considerable length. The theories of Wright, Lambert, Herschel, Struve, Proctor, and others, as to the construction of the visible universe and the laws governing the distribution of stars, are described and critically examined. There is a very interesting chapter on stellar parallax and stellar motions in which the latest information on these important subjects is given. Speaking of the sun's motion in space, the author asks, What was the position of our system in past geologic time? If the motion has been rectilinear we must have come from that part of space in which Sirius is at present situated. "Now, with a parallax of 0·39" the distance of Sirius from the earth would be about 49 billions of miles. With a velocity of 14 miles a second the sun's annual motion would be nearly 442 millions of miles. Therefore in 200,000 years the distance traversed would be about 88 billions of miles, which, carried back, would place it out in space far beyond the distance of Sirius." It is thus safe to say that the Ichthyosauri of the Lias must have looked upon a system of stellar distribution very different from that which we now see.

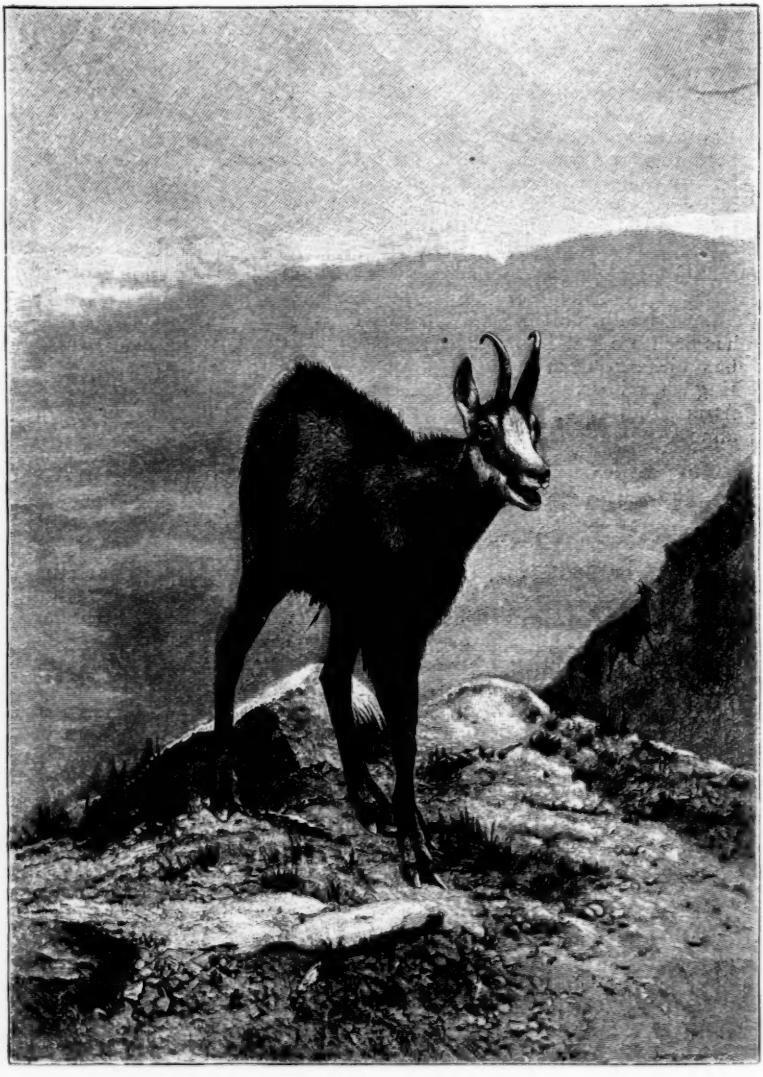
The book appeals to many classes of readers. Those who like to revel in metaphysical subtleties will find portions adapted to their peculiar taste; those who prefer to trace the work of individuals in the present state of our knowledge will turn to the historical parts; while those who feel that such subjects as the above are apt to become tedious, will find plenty to occupy their attention in the descriptive portions of the volume. Too many tastes are catered for to make the book uniformly palatable to any one individual.

Among the illustrations we may select for special commendation those which represent some of the recent results of the application of photography. The magnificent photograph of the nebula in Andromeda, by Mr. Isaac Roberts, forms an appropriate frontispiece.

SHORT STALKS; or, Hunting Camps North, South, East, and West. By E. N. Buxton. 8vo. Pp. vii., 405. Illustrated. London: Stanford, 1892. Price 21s.

FROM the main title, which alone appears on the cover, it might be thought that the volume before us was a treatise on some branch of botany or horticulture, if not a novel, whereas, as a matter of fact, it is a very interesting book on "big game" shooting. It must not however, be thought that it comes merely under the designation of an ordinary book of sport, since the author gives us some very valuable information as to the habits and mode of life of the various animals treated. Moreover, Mr. Buxton has been fortunate in the localities he has selected for many of his hunting trips, whereby he has been brought into contact with animals as to whose habits there has hitherto been a dearth of information in the works of recent English writers. Sporting works on the larger mammals of Southern Africa, India, and North America are so numerous as to afford an almost superabundance of information; whereas, in regard to Eastern Asia, Europe, and North Africa there is a marked dearth of accessible and reliable observations by English sportsmen. We are, therefore, especially glad to welcome Mr. Buxton's accounts of the Sardinian Mouflon (*Ovis musimon*), of the Spanish or Pyrenean Wild Goat (*Capra pyrenaica*), of the Arui (*Ovis tragelaphus*) of North Africa, as well as of the Pasang or Persian Wild Goat (*Capra ægagrus*), and the Chamois (*Rupicapra tragus*). The majority of the twelve chapters into which the work is divided have already appeared as separate articles in various serials and newspapers, but they are now so much embellished by the addition of the excellent illustrations with which the book is adorned, that it is difficult to recognise them as the same. By the courtesy of Mr. Stanford we are enabled to reproduce one of these illustrations as a sample. In addition to these excellent portraits of the animals he describes so graphically, Mr. Buxton also incidentally introduces some charming little sketches of bird-life and scenery.

The first chapter of the book is devoted to the Mouflon, which the author describes as one of the most difficult animals to stalk which he has ever come across. The second deals with the Chamois of the Alps, while the variety inhabiting the Pyrenees is described in the ninth chapter under its Iberian name, Izzard; and here we may point out to the author that he is quite behind modern zoology in referring to this animal under the title of *Antilope rupicapra*. The third chapter is devoted to American game, where some interesting observations are recorded as to the habits of the Bighorn Sheep (*Ovis montana*); while in the fifth Mr. Buxton treats of the Arui and Mountain Gazelle of Algeria. The author appears to have been the first Englishman who has hunted these animals, and the results of his observations have already appeared in the Zoological Society's Proceedings. We are told that the name "Aoudad," so commonly applied to the Arui, is quite unknown in its native land, and the author also speaks as to the remarkable powers of concealment possessed by these animals. The Elk of Norway claims the whole of the fifth chapter; while the sixth (which originally appeared in the *Nineteenth Century*) treats of the Pasang, under the legend of "The Father of all the Goats," in allusion



MALE CHAMOIS (*Rupicapra tragus*).—*From* Buxton's "Short Stalks."

to the probability of its being the ancestor of the domestic breeds. The most interesting of all is, however, the seventh chapter, which treats of the Pyrenean wild goat. Mr. Buxton says that, in contradiction to the true Ibex, this animal largely frequents scrub-jungle, and he points out—we believe for the first time—that the inward inclination of the tips of its horns is evidently adapted to passing with ease among bushes, the true Ibex, which inhabit open country, having the tips of their horns divergent.

Other chapters, relating to Reindeer and Bear, do not call for special notice, and we accordingly conclude by congratulating both author and publisher on the production of a work which, while written professedly for the sportsman, contains much that is deserving of the best attention of the naturalist. R. L.

OUR COUNTRY'S BIRDS, AND HOW TO KNOW THEM. By W. J. Gordon. Crown 8vo. Pp. viii., 152. Illustrated. London: Day & Son, 1892. Price 6s.

MR. W. J. GORDON is already well known as the author of "Our Country's Flowers," which has attained a well-merited reputation as a handy and convenient guide to the British flora. In the work before us he has treated the birds of Britain in a somewhat similar fashion, the result being a volume which contains, perhaps, more information in a small compass than any other of equal size which has come under our notice. The great feature of Mr. Gordon's work is that every species is illustrated, and that, too, by a coloured figure, and since these figures have been executed by Messrs. Willis and Holding, any comment as to the excellence of their execution would be superfluous. Mr. Gordon, we are glad to see, rather ridicules the idea of including such birds as the Flamingo under the title of British, but as the species has occurred in the British islands, he is perforce compelled to include it in his list.

The great object of the volume is to enable any person to identify any bird he may happen to come across in the British Islands, and for this purpose Mr. Gordon provides us with an elaborately worked-out system of "keys." He is, however, careful to add that this is merely an empirical method, and has nothing to do with classification. Other chapters deal, however, fully with the classificatory portion of the subject, in the course of which the peculiarities of the bones of the skull in the different groups, as well as the subject of pterylosis, are briefly but carefully treated. An unique feature in the book is the series of tables of dimensions of all the British species.

We may point out that in including *Pandion* among the Falconidæ the author is not up to date, we ourselves being persuaded of the correctness of the view that this genus represents an order connecting the Accipitres with the Striges. We cannot, moreover, accept the inclusion of all the Passerines in a single family "Passeridæ."

These, however, are comparatively small defects, and the author is to be congratulated on having given such a large amount of information on British birds in such an exceedingly small compass.

R. L.

THE BUILDING OF THE BRITISH ISLES: A Study in Geographical Evolution. By A. J. Jukes-Browne, B.A., F.G.S. Second edition. Pp. xiv., 465. 8vo. London: George Bell & Sons, 1892. Price 7s. 6d.

ONE object of geological enquiry is to picture the physical conditions that attended the deposition of the many geological formations. In its most interesting aspect, the subject is inseparably connected with

the natural history of successive periods; but from this broad point of view all sorts and conditions of life and of land and water would have to be considered.

In the present work the author endeavours to picture the changes in the distribution of land and water, over the area now occupied by the British Islands, during each of the great epochs of time which make up our geological sequence. His task is a most difficult one, for few geologists have been tempted to draw boundary-lines to mark the former limits of formations, however well they may be acquainted with them. It is one thing to picture in the imagination former general geological conditions; it is quite another thing to draw the outlines of land and water and to fill in conjectural rivers and lakes. The subject, like discussions on theology, is apt to lead to almost endless diversity of opinion, for (as the author admits) the materials for forming a definite judgment are so imperfect.

That his work is appreciated, is shown by the issue of a second edition, in which the author has added over a hundred pages of further information. Altogether there are fifteen plates drawn to show the geography of different epochs. Three of these are new, six remain the same as in the first edition, and six have been subject to alteration. Several other small maps and sections are printed with the text. One of the principal alterations is in the map of the Ordovician period (Arenig Epoch); we notice also that a small lake is introduced into the Devonshire and Cornish area, in the map that represents the Permian period.

Whatever value the maps may possess, there can be no doubt that the author has brought together, in a most painstaking way, a large amount of material bearing on the physical geography of our bygone ages. He concludes with a chapter on the Supposed Permanence of Continents and Oceans, and with an appendix on the Sub-oceanic Crust.

LES ALPES FRANÇAIS, LES MONTAGNES, LES EAUX, LES GLACIERS, LES PHÉNOMÈNES DE L'ATMOSPHÈRE. [Bibliothèque Scientifique Contemporaine.] By Albert Falsan. Pp. 288. Illustrated. Paris: J. B. Baillière et Fils, 1893. Price 3fr. 50c.

IN a little volume of 280 pages, Monsieur Falsan has given a readable account of the French Alps, their geology, physical geography, and meteorology. The author's extensive experience and well-known writings will attest his competence to speak on the subject, and we need only add that the condensation from larger works has been carefully and judiciously made. The nature of Monsieur Falsan's special studies leads to marked prominence being given to the glaciers and ancient glacial phenomena, and to the Tertiary geology of the Alps. The chapters on these subjects are particularly good, and to them the geologist will naturally turn.

A CATALOGUE OF BRITISH JURASSIC GASTEROPODA. By W. H. Hudleston, F.R.S., and Edward Wilson, F.G.S. Pp. xxxiv., 148. London: Dulau and Co., 1892. Price 7s. 6d.

THIS work, although it embraces a comparatively small section of our British Fossils, is a most important addition to that series which we hope will eventually replace the famous Morris' Catalogue. Nearly forty years have elapsed since the second edition of Morris' work was published. In that volume only five species of Gasteropoda are

quoted from the Lias; now 319 species are enumerated. Altogether, the authors of the present Catalogue record 1,015 species, and they have reduced the lists by something like 150 names of doubtfully identified foreign or imperfectly-constituted British species.

This new volume is the second contribution to Catalogues of British Fossils, Messrs. Woodward and Sherborn's Vertebrata appearing in 1890. We constantly use the old classic now, and considering the vast amount of work that has been done in the past forty years, it will readily be understood how useful must be a recent book of a similar kind that fully arranges our present knowledge. It is gratifying to find that the labour has so far been undertaken by those specially qualified to do it.

We should like, however, to make some remarks on a few points which might, in our opinion, have been more carefully studied. In the first place, the authors do not distinguish between James Sowerby and James de Carle Sowerby, a careless practice of some English palæontologists which has several times been pointed out to us by continental workers. Secondly, there is a great inconsistency in giving dates; sometimes a separate work is quoted with and sometimes without date, and the same may be said of serials. Considering the authors do not attempt exact dating in their bibliography, the reader is left hopelessly in the lurch, and has after all to seek his reference for himself in some public library.

We are glad to see that when quoting pre-Linnean genera, the first Linnean authority is also given, though from the method of quotation one is almost led to believe that the pre-Linnean author's name is accepted. The entry *Cerithium*, for instance, would be more accurately expressed thus: *Cerithium*, Bruguière, 1792 (*ex* Adanson, 1757). It is also gratifying to note that the 10th and not the 12th edition of Linnæus' "Systema" is used.

With regard to the generic determination of some of the mollusca, we think that a more detailed study of recent forms and recent continental work upon them would have enabled the authors to more exactly arrange the various Cerithiform, Naticiform, and Trochiform groups; and although the authors have some remarks (pp. 18—23) on several genera, we are loth to believe that all the "species" quoted under *Cerithium*, *Chemnitzia*, *Natica*, *Trochus* and *Turbo* properly belong to these genera. We are especially dubious as regards the first, third, and fourth genus, in which the characteristic features can only be seen in perfectly-preserved or completely disentombed specimens.

The sundry new names used in the volume might have been listed on p. xxxiv., now a blank; as it is we are told to "find six faces" in the style of the puzzle-pictures.

The general get-up is good, but the paper is too thick and clumsy, and the book takes up one inch, instead of half-an-inch, of already seriously overcrowded shelves.

FOSSIL PLANTS AS TESTS OF CLIMATE. By A. C. Seward, M.A., F.G.S. [Sedgwick Prize Essay for 1892.] Pp. 151. London: C. J. Clay & Sons, 1892. Price 5s.

THIS Sedgwick Prize Essay is a useful compilation, the author having brought together all the botanical evidence of former climatic conditions. Most of the opinions quoted are, however, extremely speculative, and of little value, and, wisely, Mr. Seward seldom ventures an opinion of his own on so difficult a subject as bygone climatic changes.

As far back as plants are known, even in the problematical *Nematophycus* of the Silurian, rings of growth are visible in certain orders, but whether these are true "annual rings" we have no means of telling. When we study the evidence derived from fossil floras found within the Arctic regions, we are on safer ground, for the Devonian, Carboniferous, Jurassic, Cretaceous, and Lower Tertiary plants could not possibly have lived there under present climatic conditions. Still clearer is the evidence when we come to more recent times, and find alternating deposits containing northern and southern plants of existing species.

LES LICHENS. By A. Acloque. [Bibliothèque Scientifique Contemporaine.] Pp. viii., 376. Illustrated. Paris: J. B. Baillière et Fils, 1893. Price 3fr. 50c.

THE French people are happy in the possession of a popular scientific literature of excellent quality and moderate price, of which they are justly to be envied. They produce books now and then, however, of which no nation envies them, and this is one. In the matter of bad popular books on fungi and lichens this country might be thoughtlessly considered to hold the record, but it is refreshing to know that while our neighbours can beat us easily in serious research on these subjects, they can also show us the way in the matter of poor productions. It is almost enough to say of this little popular book on the study of lichens that its benighted author rejects Schwendener's great discovery of the dual nature of lichens, and the symbiotic phenomena they illustrate. It is hard to do more than prove a matter, and after the establishment of this great fact by the researches of De Bary, Schwendener, Stahl, Bornet, and others, it was confidently expected that the old lichenological school would die out. It is dying, however, like a vested interest, and the patent rights in "homæogonidisme" have been leased afresh by M. Acloque. His little book shows a most superficial knowledge of morphology in general, and the text is not much better than the figures, which are all that is not to be desired.

NAKED-EYE BOTANY. By F. E. Kitchener, M.A., F.L.S. [Beginners' Text-Books of Science.] Small 8vo. Pp. xii. and 182. London: Percival & Co., 1892. Price 2s. 6d. net.

THE series of elementary science text-books of which this is the first, has been projected to meet the want, long-felt, of something which will cover the ground of a few terms' lectures and serve the pupils as a supplement to those lectures. The volume comprises 48 lessons, which may "be got up by the pupil by himself as prepared work," or "taken in school unprepared with the help of a running commentary from the master in the form of a catechetical lecture." These two objects are widely different, and demand very different treatment; with the help of a "running commentary" from a competent master the work before us may be of some use, but it is not one to put into the hands of a beginner to "get up" alone. As lecture-skeletons on various types of flowers, the book may be a help to busy teachers, but they must be careful to explain crude statements and correct erroneous ones, such, for instance, as "the leaf-stalk may be traced as carried on through the leaf to its apex, and sends out branches (or veins) on each side arranged like a feather," the definition

of stipules as "two small leaves at the base of the leaf-stalk," or the description of the position of the leaves of the iris "at the root (radical)." Knowing the very intimate connection between respiration and life, whether of plant or animal, it is surprising to find this important function of the whole plant disposed of in a few lines thus: "In the absorption of oxygen from the air, it is not so much the foliage leaves that take part as the leaves that are not green, the parts of the plant that are in flower; these plants perform, when not in the sunlight, a process akin to that which all animals perform, viz., they take in oxygen gas dissolved in water, and send out the oxygen combined with carbon under the form of carbon dioxide dissolved in water."

We know that respiration is more vigorous in opening flowers and germinating seeds, but this is only because life, expressed as more rapid growth and demanding a co-ordinated supply of energy, is "faster"; just as a man breathes harder with increased effort.

It is only fair to state that these faults preponderate in the earlier lessons; where the author confines himself to descriptions of plants he is more at home, and many of the lessons, *e.g.*, that on the Rose-family, are good.

In spite of the title "Naked Eye Botany," the pupil, as stated in the preface, will find a lens useful, and often indispensable, in the floral dissections.

At the end of each lesson problems are presented to be done out of school. Many are good and suggestive, some hopelessly beyond the pupil. At the end of the first lesson, one on the chickweed, he is asked whether "animals move about and plants are fixed in the ground" is an invariable rule, and invited to mention exceptions; several relating to insect visits and fertilisation are introduced with hardly any previous instruction on the subject.

In the table for determining the natural orders of British flowering plants, no notice is taken of exceptions, so that *Clematis*, *Anemone* and other apetalous Polypetalæ would be sought for among the Apetalæ. We notice, too, that both the goose-foot and polygonum family are styled Polygonaceæ.

The book is no worse than many of its kind; better than some. It illustrates for the hundredth time the fact that it takes the best men in a subject to write a good elementary text-book.

Systematic botanists, and those who make a hobby of the Iris family, will welcome the appearance of Mr. J. G. Baker's monograph on Irideæ (George Bell & Sons). It is uniform with the author's works on the Fern allies, the Amaryllidaceæ and Bromeliaceæ. Mr. Baker speaks of it as the last of the series, but we hope this will not be the case; the Scitamineæ want working up again, for Horaninow's monograph might well give way to a more modern one, and if Mr. Baker took it up we should be sure of having it well done.

Professor Baillon's *Histoire des plantes* (Paris: Hachette & Co.) has reached the twelfth volume, the first part of which, just to hand, includes the Conifers and other Gymnosperms, with the monocotyledonous orders, Alismaceæ, Najadaceæ, Typhaceæ, the curious little tropical Triurideæ, and the equally strange, almost exclusive, Australian Centrolepideæ. The excellence of the previous volumes

is maintained both in the text and illustrations. We notice that *Casuarina* now figures as a tribe of Conifers, though with a query, and the remark that wherever placed they constitute a distinct group, which has been compared on as good grounds with the Cryptogams. We regret that the author has followed the change of nomenclature recently introduced by Kuntze, which substitutes *Podocarpus*, the accepted name of a large and well-known genus, for the equally well-known, but very different, *Phyllocladus*, makes the *Sequoia* an *Arthrotaxis*, and for *Welwitschia* writes *Tumboa*.

DR. P. L. SCLATER has issued a privately-printed *New List of Chilian Birds*, compiled by the late Harry Berkeley James. Some time ago Messrs. Sclater and James agreed to co-operate in the preparation of a work on the Birds of Chili, as a companion volume to Sclater and Hudson's *Argentine Ornithology*. The lamented death of Mr. James last July arrested progress, and his preliminary list of birds, compiled as a basis for the work, is now published by Dr. Sclater, and prefaced by a short biographical notice.

MESSRS. GEORGE PHILIP & SON'S *Child-Life Almanac* (price 1s.) will interest not only children, but nature-lovers of all ages. The aim is to provide kindergarten teachers with suggestions for lessons and observations. The recurring facts of natural history, and the principal events in the social, political, and intellectual life of the country, will serve as pegs on which to hang instruction. The idea is well carried out. The twelve sheets, each 11 × 8 inches, record not only a goodly number of events of common or special interest, but also in a parallel column, a list of phenological observations, the times of appearing of flowers, birds, and insects, of the singing or departure of the birds, the leafing or leaf-fall of our common trees, and many other facts which should be of interest. Hints are also given as to out-of-door work available for the time of year, and general observations on pond-life, moth-hunting, bees, or gardening.

Finally, two prizes of a guinea, one for adults and one for children, are offered for the most complete set of phenological notes for 1893, prepared from actual observation, confirming or supplementing those of the almanac. We hope Messrs. Philip will receive a goodly number of sets. Efforts to increase the interest in the study of Nature deserve support. The almanac is very neatly arranged and printed in a somewhat effective cover.

OBITUARY.

HENRY TIBBETS STAINTON.

BORN AUGUST 13, 1822. DIED DECEMBER 2, 1892.

WE regret to record the death of this eminent entomologist, an acknowledged leader in the science at home and abroad. Mr. Stainton was one of the highest authorities on the Lepidoptera, especially on the smaller moths, and most particularly on the Tineina, a group in knowledge of which he had been, of late years, without a rival. Like most naturalists, Mr. Stainton had a taste for his subject from his early youth, as he began to collect insects when only twelve years old. He continued faithful to the Lepidoptera throughout his life; and though the groups to which he mainly devoted his attention do not attract the ordinary amateur, their study is of great importance, and the life-histories of many of the Tineina are of surpassing interest. In the study of these minute moths, Mr. Stainton was associated with the great German lepidopterist, Zeller. By their labours the classification of the Microlepidoptera was brought into a natural sequence, and the genera established on good structural characters, a consummation still to be wished for in some of the groups of larger moths. The *Natural History of the Tineina* in four languages was the joint work of Stainton, Zeller, Douglas, and Frey, and appeared in thirteen volumes between 1855 and 1873. Mr. Stainton had published a work on *British Tineina* in 1854; in 1857 he published the *Tineina of Syria and Asia Minor*, and, in 1869, the *Tineina of Southern Europe*. In numerous papers in the entomological journals he elucidated the life-histories of the smaller British moths, and made many additions to our fauna. But his general work on the *British Lepidoptera*, published in two volumes (1857–9), shows his acquaintance with the order as a whole, and is still the most useful book on the subject for the working entomologist; though being mostly composed of synoptical tables and technical descriptions, with numerous abbreviations, it is not attractive to the general reader.

Mr. Stainton will be remembered for his activity in the field of entomological journalism. For twenty years, from 1855 to 1875, he issued his *Entomologists' Annual*; and for ten years, from 1856 to 1866, he conducted the *Entomologists' Weekly Intelligencer*, the only British journal on the subject that ever appeared weekly. From 1864 till his death, he was on the editorial staff of the *Entomologists' Monthly*

Magazine, and until last year he was a frequent contributor to its pages. He was a member of many learned societies, and was elected F.R.S., a rare honour for a systematic zoologist, in 1867. Courteous to all who applied to him for information, personally or by letter, and always ready to place his great knowledge and extensive collections at the service of students, he leaves an example of the best traditions of English naturalists.

AMONG other recent deaths we also have to chronicle those of FLAXMAN SPURRELL, of Crayford, an ardent botanist, who also began the great collection of Pleistocene Mammalia from the Thames Valley, now long utilised and extended by his son, Mr. F. C. J. Spurrell; of W. MATTIEU WILLIAMS, the well-known author of many popular treatises and magazine articles; of the veteran conchologist, P. M. A. MORELET; of two cryptogamic botanists, Baron FELIX VON THÜMEN and C. M. GOTTSCHE, both distinguished for their labours among mosses and hepaticæ; and of ALEXANDER SKOFITZ, founder and editor of the Austrian *Botanische Zeitschrift*.

THE death is announced of the veteran American Professor of Geology, Dr. JOHN STRONG NEWBERRY. We hope to give some account of his life and work next month.

THE death of Sir Richard Owen, K.C.B., on December 18, 1892, is noticed on p. 17.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

Dr. G. von Lagerheim, late Director of the Botanic Garden of Quito, has been appointed Curator of the Tromsö Museum, Norway.

Messrs. W. T. Swingle and W. J. Webber have been appointed to direct the newly-founded "Station for Citrous Diseases" at Eustis, Florida.

Mr. E. W. MacBride, M.A., has been appointed Demonstrator in Animal Morphology in the University of Cambridge.

Dr. C. S. Minot has been appointed Professor of Histology and Embryology in Harvard Medical College; and Dr. Harris H. Wilder has been elected to the Chair of Biology in Smith College, Northampton, Mass.

Mr. Joseph E. Carne, late Curator of the Mining and Geological Museum, Sydney, has been appointed a Geological Surveyor in the Department of Mines, New South Wales.

Mr. Edgar R. Waite, for some years Curator of the Leeds Philosophical Society's Museum, and joint editor of *The Naturalist*, has been appointed assistant-curator of the Australian Museum, Sydney. Mr. Waite leaves England early in February.

Dr. F. Elfving has been appointed Professor of Botany in the University of Helsingfors, Finland; and Professor W. R. Dudley has left Cornell University for the Leland Stanford Junior University, Palo Alto, California. Mr. G. F. Atkinson now becomes Assistant Professor of Cryptogamic Botany at Cornell.

Mr. Francis Darwin, Reader in Botany at the University of Cambridge, has been appointed Deputy-Professor of Botany, owing to the ill-health of Professor Babington. Professor Babington has held the post for more than thirty years, and for some time past has taken no active part in the management of the School of Botany, which was so well worked up by Dr. Vines, now Professor at Oxford. Mr. Francis Darwin is well known, both from association with his father in much of the great naturalist's botanical work, especially the "Movement of Plants," and from his own researches in the physiology and biology of plants.

The foundation stone of an extension of the buildings of the Durham College of Science, Newcastle-on-Tyne, was laid by the Earl of Durham last month.

UNDER the direction of Professor Osborn, a series of lectures on the results of current researches in Biology is being delivered this session at the Columbia College, New York. The course is arranged to meet the requirements of advanced students and biologists engaged in research.

ACCORDING to the *American Naturalist* the new Natural History Institute of the University of Illinois, at Champaign, was opened on November 16 last. The cost of the building was about 78,000 dollars, and it will contain the Natural History library (of 20,000 volumes), museum, laboratories, and lecture rooms.

THE Town Council of Ipswich has decided to open the Museum and Public Library on Sunday afternoons.

WE are glad to learn that the Yorkshire Philosophical Society has reduced the admission fee for the York Museum on Saturday afternoons to the small sum of one penny. This generous concession to the public is much appreciated.

THE shareholders of the Bristol Museum and Library have now confirmed their resolution, to offer their property as a gift to the City of Bristol. The discussion of the subject seems to have been chiefly confined to the library, but we hope that some naturalist of influence will be found to watch the interests of the museum. Fortunately, the valuable collections are safeguarded by the endowment fund, which necessitates the interference of the trustees of the British Museum, and their sanction to whatever arrangements may be made.

A FUND for the benefit of the widow and daughter of the late Mr. T. J. Moore, formerly curator of the Liverpool Museum, is being collected by a local committee, of which the Rev. H. H. Higgins is treasurer, and Mr. Richard Paden secretary. Contributions addressed to either of these gentlemen at the Liverpool Museum will be gladly received.

THE plans of the Sedgwick Geological Museum were under discussion at Cambridge last month, and there now seems to be a prospect of the early realisation of the long-projected scheme for a new Memorial Museum. The staff of the Geological Department of the University is also to be increased by the addition of a Demonstrator in Palæozoology.

A HANDBOOK for the Department of Geology in the United States National Museum is in course of publication. Part i., by Mr. George P. Merrill, deals with the Materials of the Earth's Crust, and forms not only a useful guide to the Rock-collection, but also a concise introduction to Petrology. It is illustrated with photographic plates that clearly show various kinds of rock-structure, as seen both in mass and under the microscope.

THE Right Hon. John Morley was elected a Fellow of the Royal Society of London on December 15.

THE Royal Geographical Society's monthly Proceedings appear this month and henceforth under the title of *The Geographical Journal*.

THE section of Medicine and Surgery of the French Academy of Sciences some time ago formed a committee to arrange for an address of congratulation to be

presented to M. Pasteur on the occasion of the seventieth anniversary of his birthday. Subscriptions were received, and a gold medal accompanied the address that was presented to the veteran pathologist on December 27.

THE 150th anniversary of the foundation of the American Philosophical Society will be celebrated at Philadelphia from May 22 to May 26, 1893.

WHEN is the Catalogue of the Linnean Society's Library destined to appear? It has been promised to the Fellows for several years, and so far there has been no fulfilment. The Linnean Society's Library is so useful to a large body of workers, and the courtesy and helpfulness of the officers and staff are so abundant, that there has been hitherto no public grumbling on the subject. It is to be hoped that an energetic effort will soon be made to bring out the Catalogue, since its absence considerably impairs the efficiency of this branch of the Society's work.

THE Yorkshire Naturalists' Union has issued as the seventeenth part of its Transactions another instalment of Mr. J. G. Baker's "North Yorkshire." This is the fifth part of the work, and contains a list of the Flora from *Pyrola* to *Scsleria*. The next part will complete the flowering plants, and commence the mosses and hepatics.

THE North Staffordshire Naturalists' Field Club has issued vol. xxvi. of its *Transactions* (1892). The Garner Memorial Medal has now been established, and will be awarded in alternate years for original researches in the Society's district. The Council regrets that funds do not allow of an annual award. The medal will be of silver, or, at the option of the recipient, it may be substituted by a bronze medal and a gift of books.

THE last part of the *Proceedings of the Yorkshire Geological and Polytechnic Society* (vol. xii., pt. ii., 1892) contains an important illustrated account of the exploration of a tumulus at Howe Hill, Duggleby, by J. R. Mortimer. Other papers relating to the county are a description of the geology of Grassington and Wensleydale by J. R. Dakyns, notes on Flamborough Drifts by G. W. Lamplugh, and a summary of the Lias and Oolite formations by James W. Davis, the editor. Mr. G. R. Vine has a detailed memoir on some Cretaceous Polyzoa, and Dr. Tempest Anderson contributes some personal observations on the volcanoes of Iceland.

THE Palæontographical Society is to be congratulated on having issued its volume of monographs for 1892 within the year to which the subscription relates. The volume contains the final part of Professor Nicholson's monograph on Stromatoporoids, and further instalments of the monographs of Jones and Woodward (Palæozoic Phyllopoda), Hudleston (Jurassic Gasteropoda), Buckman (Lower Oolite Ammonites), and Whidborne (Devonian Fauna of S. England). The plates and illustrations are of the usual high standard, but there is a marked preponderance of illustrations of ammonites; the Society's stock of plates of these fossils long in hand must by this time be almost exhausted. We have on a former occasion referred to the misleading list of "announcements," and regret to find that it still remains unrevised. In the case of several of these monographs announced as "in preparation," we believe the statement is false, and that members of Council are aware of the fact; indeed, the Treasurer of the Society (Mr. R. Etheridge, F.R.S.) authorises us to state that he is *not* preparing the two memoirs placed under his name, and has no intention of doing so. The length of the list of subscribers is gratifying, but the false promises made by the Council are not calculated to retain this support, as soon as the true state of affairs is discovered.

CORRESPONDENCE.

Experimental Evolution.

In the last number or Natural Science, P. C. M. delivers some criticism o my lectures on Experimental Evolution. He is quite right in criticising me when he says that "While royal food may ripen the latent sex of a worker (*re* bees) a different factor has to do with the distinction between male and female." I should have said that *sexuality*, *i.e.*, the development of sex, or the possession of sex, may be determined by food; *sex* is not determined thus, as while unfertilised eggs develop only into drones, fertilised eggs, according to circumstances—and food—develop into queens *or* workers.

But when P. C M. says, concerning the statement that "we possess in the facts of domestication and inheritance a large number of cases of variation, which occurs in every part, due to environment, and transmitted in various degrees," that "if the statement were true there would be no controversy," this is a rather sweeping criticism. There are five distinct propositions in this statement. Does P. C. M. object to all, or only to part of them? Does he deny variation due to cultivation and domestication? does he deny the occurrence of variation in every part of organisms? does he deny only the fact that variation is due to environment? or does he object to its hereditary transmission? I grant that, in ascribing variation to environment only, I would be saying more than I am prepared to assert, as, in fact, the cause or causes of variation are unknown; but environment in its broad sense seems to have something to do with variation, as many facts go to show. P. C. M. may certainly object to part of my statement, but it would be fair, if only towards his readers, if he stated which part he considers as most heretical.

The same critic informs me that Professor Le Conte's classification of the factors of evolution is "curiously inept," and charges me with approval thereof, which surely cannot improve my situation. However, I must decidedly object to a method (?) of criticism (??) which consists in quoting part of a statement and leaving out the remainder. I have merely given Le Conte's list of "what the factors of evolution are, or are supposed to be" (p. 229: there is not much approval in this), and if P. C. M. had taken the trouble to go on with the quotation, and to quote what I say of this list (which, in fact, is a mere enumeration of the principal factors of evolution proposed on different sides, a mere catalogue), he would have seen that I state that "the five factors are not all recognised by the same group of evolutionists," the two first being especially Lamarckian, and that, in my opinion, no definite view concerning the real value of these different factors can be entertained as long as all have not been subjected to the test of experiment.

If I have "approved" of the list, I do not see that I can be considered as having approved of the scientific soundness of the views expressed in it, inasmuch as no one does adhere simultaneously to each of the five views expressed, and I should be the last to do so, since I ask for proofs of *each* and *all*.

P. C. M. ends with a very virtuous and mighty sentence, which, abridged, might be of high moral use in a copy-book; but I fail to see how it applies to myself. I have not the slightest wish to confound anybody, nor am I familiar with the devices of political controversy—which, I perceive, are exceedingly wicked—and while advocating, from the first to the last page, the necessity of submitting theories to the test of experiment, in order to ascertain the exact situation of that swift-footed fugitive, truth, I certainly did not expect to be charged with resorting to methods which are not only unscientific, but, strictly speaking, unfair.

Paris, *November*, 1892. Henry de Varigny.

[DR. DE VARIGNY brings forward the statement that "we possess, in the facts of domestication," &c., in support of his view that Professor Weismann goes too far when he asserts that we have no proof of the direct production of transmissible changes by means of external influences. As used, the sentence amounts to a single statement that we know many cases of variations due to environment being transmitted.

The whole controversy to which Dr. de Varigny is alluding, concerns the statement which he brings up as an argument on one side of the controversy.

In the matter of Le Conte, I am sorry that I attributed to Dr. de Varigny an approval he now disowns. He wrote (p. 229):—

"What can the methods of experimental transformism be? The only answer to this question is based on the consideration of what the factors of evolution are, or are supposed to be. At the present moment five are usually recognised. I quote from Le Conte's able paper of recent date."

In the two "factors" I quoted in my review, Le Conte runs together the observed facts of phylogenetic variation and phylogenetic decay of disused parts, with the theory that the result of the action of environment is inherited and integrated. A chief object of "experimental transformism" must be to decide on these theories, and any "method" involving preliminary acceptance or rejection of them is valueless.

I do not consider Dr. de Varigny's statements heretical, but if I did it would be of no interest to anyone. I merely showed that they were confused.

P. C. M.]

THE INTERIOR OF THE EARTH.

IN the summary of my late paper in the *Proc. Cambridge Phil. Soc.*, given in "Notes and Comments" of December, there are two points to which I wish to be permitted to refer. It is stated that I have "reinvestigated mathematically" the effects of a tidal yielding of the earth on a tide of short period, according to the canal theory. Professor Darwin had already made that investigation, and there was, consequently, no need to do it over again. But he had left his result in the form of general symbols, and what I have done is to carry his calculation a step further by substituting for the symbols their known astronomical values. It was in this way that I arrived at a conclusion to what extent the ocean tide might be expected to be diminished if the interior of the earth is liquid.

The Reviewer has, however, given my result incorrectly in saying that I have found that the tide, in the case of a liquid interior, "would be about two-fifths of what it would be" in the case of the earth being solid. What I did say was, that it would be *diminished* by two-fifths if the earth was taken as homogeneous, but only by one-fifth when the fact is taken into account that the outer parts of the earth are of half the mean density. This, of course, will leave four-fifths of the height on a solid earth for the height on a liquid earth. For instance, if the height of the tide from highest to lowest on a solid earth were fifty inches, it would still be forty inches if the interior were liquid. Since we do not know what the exact height of the tide would be on a solid earth, it is perfectly possible that the tides actually experienced may be of the height appropriate to a liquid interior, seeing the diminution caused by liquidity to be so small.

On a review of the whole question, it appears to me that what had been previously done by Lord Kelvin and Professor Darwin, and other mathematicians, had been to show that, unless the earth is excessively rigid, the tidal forces must deform it. But it had been *assumed* that, if so deformed, it would carry the water up and down with it, so that the ocean tides would not be noticeable; but the question whether or not this assumption was valid, had never, so far as I know, been brought to the test of numbers until I made the attempt.

O. FISHER.

Harlton, Cambridge, *December* 12, 1892.

THE WALK OF ARTHROPODS.

I WOULD like to supplement my paper on the "Walk of Arthropods" (NAT. SCI., vol. i., p. 676) by calling attention to Mr. Dixon's description of his researches, in *Nature*, vol. xlvii., p. 56, in which some additional details are given, not included in the paper reviewed by me. The spider *(Tarentula)* when running on water caused depressions of the surface-film which were projected as dark shadows on the bottom of the vessel. No shadows were cast by the foremost pair of legs, which proves that the spider, like the insects, has a triangular base of support. The walk of centipedes is also described; the legs are said to move in alternate sets of three.

In referring to investigators of the walk of insects, I regret that I omitted to refer to Professors Miall and Denny, who in their book on the cockroach (p. 79) give a short but excellent account of the locomotion of insects.

Dublin, *December*, 1892. G. H. CARPENTER.

TO CORRESPONDENTS.

All communications for the EDITOR *to be addressed to the* EDITORIAL OFFICES, 67–69 *Chancery Lane, London, W.C.*

The PUBLISHERS *require a few copies of the October number* (*no.* 8) *of* NATURAL SCIENCE. *Full price, with postage, will be paid for clean copies not folded, addressed to* MACMILLAN & CO., 29 *Bedford Street, Strand, London, W.C., until the demand is supplied.*

PROFESSOR W. A. HERDMAN (University College, Liverpool) contemplates the preparation of a Handbook to the British Marine Fauna, and desires to receive suggestions from naturalists interested in the subject. He will also be glad to hear from specialists who are willing to co-operate with him in the compilation. The Professor proposes that the work should be a "pocket" or "seaside" handbook, which could be used in much the same way as the botanists' "Field Flora." It might comprise four to six small volumes, each dealing with one or two of the large groups. There would be definitions—perhaps with occasional analytical tables or keys—of orders, families, &c., down to and including genera. Abbreviated descriptions of species would be added, with an indication of size, range, and habitat. Simple figures would be given of all structural features of diagnostic value in the various genera and species.